

DOCUMENT RESUME

ED 416 835

IR 018 732

AUTHOR Hawkridge, David, Ed.
TITLE ALT-C 95: Changing Education, Changing Technology.
Conference Abstracts of the Association for Learning
Technology Conference (2nd, Milton Keynes, England, United
Kingdom, September 11-13, 1995).
INSTITUTION Association for Learning Technology, Oxford (England).
PUB DATE 1995-09-00
NOTE 102p.
PUB TYPE Collected Works - Proceedings (021)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Computer Assisted Instruction; Courseware; *Curriculum
Development; *Educational Change; *Educational Technology;
Foreign Countries; Higher Education; Hypermedia; Internet;
Learning Strategies; Material Development; Multimedia
Instruction; Multimedia Materials
IDENTIFIERS Learning Environments; Technological Change; *Technology
Integration; United Kingdom

ABSTRACT

This program for the 1995 Association for Learning Technology Conference summarizes the presentations of the discussions, demonstrations, workshops, and poster sessions. Abstracts of the following papers presented at the conference are included: "New Structures for Learning" (Patrick Allen & Kate Sankey); "Multiple System Conferencing" (Susan Armitage & Mark Bryson); "Mixed Metaphor Systems for Accessing Hypermedia Teaching Material" (Philip Barker & Check Meng Tan); "Strategies for Using Electronic Lectures" (Philip Barker); "Student Workbooks--A Computer Based Learning Environment" (G. J. Blyth, M. S. Bloor, & R. Creasey); "New Approaches to Learning & Teaching" (Adrian C. Boucher); "CAL Evaluation at the Open University" (Philip Butcher, Ann Jones, & Canan Tosunoglu); "Practice and Approaches to IT Skills" (Robina Clayphan); "Accommodating Multiple Learner Styles and Multiple Disciplines in a Single Multimedia Learning Resource" (Roy Currie); "Hypertext Authoring in Art and Design Education" (Alan Dyer); "Evaluation of Student Perceptions of a Computer Based Laboratory Simulation" (N. S. Edward); "The Need for, and the Development of, Student Managed Support Software" (Peter Edwards); "SHAPE: A Semantic-Hypermedia Authoring Program for Education" (G. J. Elliott, Eleri Jones, & A. Cooke); "Cooperative Cross-Platform Courseware Development" (Jeff Haywood, Hamish Macleod, Brian Gilmore, & Christine Rees); "Change Management for Sustainable Educational Software" (Phil Hobbs & Simon Price); "Experiences of Managing Curriculum Development in a Large Organisation" (Ian Huntley); "Changing the Role of Tutors in Distance Education with Information and Communications Technologies" (Adrian Kirkwood, Ann Jones, & Anne Jelfs); "Replacement of Traditional Lectures with Computer Based Tutorials" (Derek Lavelle); "Beyond the Multiple Choice" (Don Mackenzie & Helen Wilkins); "The Scalability of Online Courses" (Robin Mason); "A Rationale for the Development of Personal Transferable Skills through the Use of IT in Teaching and Learning" (Audrey McCartan & Catherine Hare); "An Application of Conceptual Techniques in Education" (R. V. De Mulder, C. van Noortwijk); "Changing Media: Will A Student Want To Read a Printed Textbook When an Electronic Text is Available?" (Joe Nicolls, Mark Howes, & Rick Jones); "A New Future for Situated and Collaborative Learning and Mentorship Using the

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World Wide Web" (Michael Nott, Robert Day & Matthew Riddle); "Taking the Technology Out of Video Technology in Higher Education" (Chris O'Hagan). "The Use of Hypertext and the World Wide Web in Computer Based Assessment" (N. Parrington, R. I. Ferguson, & J. Mills); "Shrink-Wrapped Solutions Aren't" (Mark Pettigrew & Ian Huntley); "WinEcon Lecturer" (Simon Price, Li Lin Cheah & Jasper Tredgold); "Educational Computing Systems" (A. Ravenscroft, K. Tait, & I. E. Hughes); "Towards a Theory of Technological Innovation within Higher Education" (Rachael Scott & Brent Robinson); "The Use of the Internet in Distance Learning and Continuing Professional Development of Property and Construction Professionals" (Brian Sloan); "Video Conferencing in Medical Education" (Sandra Thompson); and "Horses for Courses and Tools for Teachers" (Sue Tickner). (MES)

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FOR LEARNING
TECHNOLOGY

ALT

ALT-C 95

second annual conference

*Changing
Education*

*Changing
Technology*

Monday 11 September to
Wednesday 13 September

at the Open University
Milton Keynes, UK

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Conference abstracts

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New structures for learning: some social and cognitive aspects of dialogue in computer mediated courses

Patrick Allen and Kate Sankey, University of Stirling

One of the assumptions behind this paper is that the possible widespread introduction of learning technology into the university curriculum is beginning to interrogate conventional models of teaching and learning. Indeed, such widespread introduction of learning technology will not take place unless established teaching methods are brought into question. Learning Technology is challenging the composition of existing social structures in the university. The paper will begin with an overview of some of the social parameters and conventional structures that delineate current university teaching practices (eg the tutorial, the seminar and the lecture.) In particular, some of the ways in which the dialogue between teacher and learner is normalised and regulated will be described.

New spaces within which courses are being organised are well under development (eg the teaching lab, open access to computer based teaching material, computer conferencing.) The introduction of learning technology is in a dramatic way forcing educationalists to describe these new spaces. New social structures are being formed but often without due regard to how styles of learning will themselves change in consequence. The paper will continue with a description of some of the new spaces being developed as a consequence of the introduction of learning technology. In particular, how relatively simple and inexpensive methods such as an *asynchronous tutorial* through the use of bulletin boards and on-line *journal writing* can intervene productively in the learning process.

Our example is taken from research on a part-time evening degree course at Stirling University in Environmental Research. The intention of the IT component of this course was to develop transferable understanding and thinking skills and to explore possible new ways of observing students' acquisition of knowledge and their handling of new concepts presented in the courses.

The principles that guide the course structure and choice of learning methods used at that students should:

- follow an *enquiry-based* approach
- engage in a process of *critical reflection*
- work *collaboratively* and be actively involved in the development of a *community of enquiry*

This research has enabled us to develop a theoretical understanding of the pedagogical processes which take place through the use of computer-based conferencing techniques. In particular, the role of dialogue in the formation of new concepts and the type of cognitive structures that enable a critical approach to domain knowledge.

Multiple system conferencing, or how to please all of the people all of the time

Susan Armitage and Mark Bryson, Lancaster University

Choosing a piece of computer software is never easy. Making a decision about which conference system to buy is no exception. More and more commercial companies are producing their own groupware products to support and integrate company activities, from purchasing to board meetings.

In this session we address the particular issues that arise when considering conference systems for use in supporting teaching and learning in Higher Education. If a decision is to be made centrally about which system to support, one initial problem is the diversity of activities that it will need to support, from administration to course text. Each Department, and probably each lecturer, will have their own views about pedagogy and will not appreciate a system that 'forces' one kind of teaching or learning approach on either themselves or students.

Another issue is that of legacy software, where departments have been unwilling or unable to wait for a central decision to be made and have chosen a system that best supports the activity they wish to use a conference system for. Clearly, there will be some resistance to changing to a new, possibly as yet unproven, system.

We will outline an approach being piloted at Lancaster University - that of multiple system conferencing. This approach takes as its starting point the integration of

existing and future systems, rather than trying to force people to use a single system. In this scenario people use their preferred method of electronic communication, but are not excluded from discussions on other systems.

Necessarily some restrictions will exist on which systems could be used. Software standards are an important issue. A rapidly increasing number of media types will need to be supported transparently across a variety of systems. Similarly, systems using a different conference metaphor (eg one that arranges discussions chronologically and one that uses a grapevine approach) may not make sense when represented on the other system.

Our initial experience of allowing a University-wide discussion to take place across three different systems, email, Caucus (a traditional text-based conference system) and LuBBs (Lancaster's student run bulletin board system) are used to illustrate some of the benefits of taking a multiple system approach.

Mixed metaphor systems for accessing hypermedia teaching material

Philip Barker and Cheek Meng Tan, University of Teesside

Metaphors are an important aspect of interface design and use. Their importance stems from the role that they play as cognitive transfer agents; that is, their ability to enable people to use their knowledge of one familiar domain in another less familiar one. In our research investigation a number of different types of metaphor have been investigated. These include: book metaphors; lecture metaphors; a bookshelf metaphor; and library metaphors. The book metaphor is fairly easy to use for linear multimedia publications.

However, it is more difficult to apply when non-linear hypermedia electronic books are involved - because some readers may not have cognitive structures which will enable them to handle non-linearity. It is therefore important to look for 'metaphor extenders' - mixed metaphor systems that can be used within hypermedia electronic books (such as a lecture, a laboratory or a library.)

Electronic lectures are an important mechanism for disseminating information in hypermedia form. Augmentation of such lectures is an author-oriented process which involves adding additional information to the original information in order to compensate for the absence of the live narration that takes place in a lecture situation. This technique can be used to enhance the utility of the material for individualised self-study by students. The hypermedia resources that are produced provide significant flexibility in that they enable students to access lecture material independently of time, location and individual learning pace.

In this paper will introduce an electronic library metaphor as a mechanism for organising and accessing lecture material that is published in the form of hypermedia electronic books. The library metaphor will itself embed a bookshelf which will in turn utilise a book metaphor. The hypermedia books will embed various other types of metaphor - such as a laboratory or workbench - that enable different teaching and learning approaches to be realised. Our experiences of using this metaphor as a teaching/learning resource will be illustrated by means of a case study involving the creation of a distributed electronic library facility.

Strategies for using electronic lectures

Philip Barker, University of Teesside, Ian Benest, University of York, Terry Anderson, University of Ulster

It is our contention that for some time to come lectures (in one form or another) will continue to play a major role in teaching and learning activities within higher education. But this method of teaching will be strongly influenced by developments in computing, information storage, computer networking and display technologies. Indeed, such resources can be used to improve significantly the quality of conventional lectures and, at the same time provide considerable potential for enhancing the overall quality of students' learning experiences.

Nowadays, increasing use is being made of various types of presentation tool in order to deliver electronic lectures to both small and large groups using a computer system that is attached to an appropriate projection facility. For example, Anderson uses the Microsoft PowerPoint package; copies of his electronic slides are made available to

students in the form of a paper-based course handbook. Similarly, Benest and Hague make use of an 'electronic book emulator' to prepare and deliver on-line lectures. The Book Emulator is a powerful presentation tool that runs on a SUN 3s and Indy workstations. Barker uses a low-cost, easy-to-use package (ToolBook) running on a multimedia personal computer that is attached to a local area network; copies of his slides are made available electronically through an on-line database facility to which all students have read access.

Given the above three 'scenarios' the purpose of this discussion workshop is to identify the important issues, problems, advantages and disadvantages associated with creating and using electronic lectures. It is anticipated that the workshop will provide the opportunity for participants to share their views and experiences and to debate strategies for establishing good practice.

Student workbooks - a computer based learning environment

G J Blyth, M S Bloor and R Creasey, University of Leeds

The intention behind the project was the development of an environment which would support student learning. It was envisaged that this environment be resource based and promote learning through the performance of tasks. The concept of student workbooks was used as the base metaphor. A portion of a Mechanical Engineering course entitled 'Design Methodology' was used for this pilot study.

Student Workbooks in the context of this project: A student workbook is a learning oriented package which provides access to information, tailored direction, and continuous assessment. The emphasis is on study in a library environment.

Generic Features of a Workbook based Environment: A list of necessary and desirable features was drawn up. It was envisaged that a given learning package would use whatever subset of these features was appropriate. The core features included, guidance notes, reference material, interfaces for programmed access and free browsing of material and notebooks for student input. The notebooks were to allow text input as well as linking to graphics or material from other sources such as drawings from a CAD package. For copyright reasons the bulk of the reference material was protected from copying so facilities for allowing students to create hypertext links between their own notebook and any range within a reference were included.

Implications for Students: The students were to be presented with a complete learning package and an environment which included, clearly defined learning objectives, clearly defined task objectives, pre-loaded core material, browsing and structured access to material and input facilities.

Implications for Teachers: The teachers would need to develop their material and structure the course appropriately. In particular an understanding of teaching and learning objectives and suitable approaches to assessment were seen as essential.

Implementation: The design and implementation of the workbook infrastructure concentrated on flexibility and maintenance. Tools were developed to support the teacher in rapidly and painlessly integrating word processor files and CAD output into a workbook. Teachers were also provided with a tool to permit inspection of the students work. From a student viewpoint the interface is intuitive yet powerful and adaptable.

New approaches to learning & teaching: student-centred modelling with object-oriented simulation tools

Adrian C Boucher, University of Warwick

The techniques of Systems Thinking and System Dynamics are rooted in the work of Forrester et al, developed some 30 years ago at the Massachusetts Institute of Technology, and subsequently much-refined. Although long-established as a technique for analysing the qualitative behaviour of complex systems in a range of academic disciplines, making System Dynamics models operational until recently required the practitioner either to program a computer to solve a specific systems modelling problem, or to learn a procedural simulation language such as DYNAMO and related high-level language modelling environments such as DYMAP2.

More recently, the development of object-oriented modelling and simulation environments which run under graphics-based operating systems (Apple Macintosh and

Windows) such as STELLA, PowerSim (Model Data AS) and VenSim have potentially offered more transparent approaches to modelling complexity by removing the high-level language requirement. Alongside these developments, given wider access within tightened resource constraints, is requiring fundamental changes in the ways in which teaching and, especially, learning are undertaken in higher education.

One school of thought argues that developing Systems Thinking skills is as important a life skill as acquiring functional literacy, numeracy and *computeracy* in present society, but until very recently, relatively few educators had adopted this approach to learning and developing understanding.

One possible solution to providing high-quality learning about complexity in dynamic systems is through adoption of the Systems Thinking and System Dynamics paradigms, using object-oriented modelling and simulation software models which enable students to explore the behaviours of systems in a self-directed manner.

Work on this approach in pre-University education in the United States has indicated some preliminary success in inculcating cognitive skills development and metacognitive development in problem-solving among learners.

This paper will outline some preliminary work using these approaches at the Centre for Education and Industry at Warwick, as part of the development of a national resource of learning materials in elementary economics and finance, with a view to developing fluency and literacy in comprehension, and applying economic understanding to a broad range of financial matters. The paper will indicate future directions for research, development of a national resource bank for teaching and learning about finance in schools at Key Stages 3 and 4, together with materials relevant for non-specialist undergraduate study, and for lifelong, continuing Education.

CAL evaluation at the Open University

Philip Butcher, Ann Jones, and Canan Tosunoglu, The Open University

In recent years, a general consensus has emerged concerning the lack of effectiveness of educational strategies and educational systems. Educational systems are finding it increasingly difficult to respond to the needs of the today's learners, highlighting the need for alternative educational strategies. The use of computers as a teaching/learning tool is one of the main suggested alternatives (supported by research findings from cognitive psychology).

The Open University has included the use of computers to support learning in its courses, since 1971 and since 1979 attempts to evaluate the OU's CAL provision have been reported in a number of publications. Despite a large volume of research into CAL evaluation, we believe that there is a need to develop a more comprehensive and systematic approach which can contribute more directly to the development of improved CAL provision. In this context, evaluation in general and CAL evaluation in particular can contribute much to the process of defining and refining educational strategies. Evaluation enables feedback into the design process and facilitates the attainment of the goals of the program as cost-effectively as possible.

The Open University has embarked on a study to find the most useful methods of evaluating the diverse types of educational software used in the university's courses. One study from this project is of a CAL program on phase diagrams, the Works Metallurgist, which is used in T203 Materials: Engineering and Science. This course with 540 students provides a sufficiently large sample for a variety of evaluation methods to be employed in a variety of settings (eg home, residential school). The methods used include questionnaires, attitude scales and quizzes in pre/post-test fashion, observations and interviews. The focus of the evaluation exercise is on the effectiveness of CAL in achieving student learning. Matters related to the educational quality of the program, instructional features in other words, are considered not in isolation from the goals of the program, but in connection with their role in helping the program to achieve its goals.

Practice and approaches to IT Skills - models of training provision

Robina Clayphan, University of Durham

Computer usage is still increasing amongst all members of the academic community and the focus has shifted from IT skills *per se* to IT in teaching and learning This

development has been encouraged by succeeding HEFC initiatives including the new Teaching Quality Assessment Method, and the impact of the outside world. To gain maximum benefit from the new technology in teaching and learning, training in the necessary skills must be provided for all potential users.

TLTP Project 45 - Core IT Skills for Teaching and Learning: Tools for the Development of a National Framework. Part of the initial phase of the project has entailed visiting a variety of Universities to gather information relating to student IT training. The findings have suggested that although individual variations do exist a broad classification of current practice can be discerned and that this may be of use to other institutions seeking to develop their provision or change their focus to one that is more oriented towards integrating IT in teaching and learning.

These broad categories are identifiable at two levels - firstly the institutional level where it is seen in the approach to IT training. Secondly in the working models of training delivery resulting from each of these approaches.

Level 1: Institutional approaches

Three approaches have been identified reflecting the attitudes towards, location and form of the training that is on offer, named Localised, Institutional and Integrated. These three types are not rigid definitions. An institution may fit most comfortably in one but manifest characteristics from another.

Level 2: Models of training resulting from the three approaches

Within each approach the implementation of training provision differs from one institution to another.

Localised models vary according to which departments have taken the initiative and to what level, but all have certain features in common.

Institutional models tend to be variations on the theme of centralised provision. Characterised by their similarities rather than differences they can be seen as lying along a spectrum from being a separate activity to having a measure of integration with academic courses.

Integrated models can be identified and named as distinguishable types, namely, Comprehensive, Academic and Trading Company.

Accommodating multiple learner styles and multiple disciplines in a single multimedia learning resource

Roy Currie, University of Central Lancashire

The LANCAL (Lancashire Computer Assisted Learning) system has been designed as generic multimedia delivery tool suitable for the development of computer assisted learning materials in a wide range of subjects. LANCAL employs a highly modular architecture, with components for the structured presentation of course material, hypermedia networking of course material, on-line assessment and learning needs advice, content browsers and a suite of customisable interactive components for subject specific learning activities.

The system is currently being employed for the production of 11 CD ROM titles on introductory marketing through the UK centrally funded Teaching and Learning Technologies programme (TLTP), 3 CD ROM titles on waste management through a EU funded EUROFORM project, and titles on midwifery and psychology through internal initiatives at the University of Central Lancashire. A suite of tools is under development to provide assistance to academic staff who are producing learning materials for delivery with the LANCAL system.

LANCAL has been designed for speed and efficiency in the production of computer assisted learning materials. Media production overheads are optimised through the use of media items in multiple contexts eg an image can be used as an illustration in a tutorial, an annotated node in the hypermedia network and linked to a test item in the assessment section. All LANCAL titles are media rich, containing in the order of 70 minutes of video clips, 200 images and graphics, 110 multiple choice question items in addition to large volumes of text.

Support for multiple learner styles is achieved through the dynamic way in which the learner can move between modules. This enables the conservative learner to be highly supported in structured tutorial sessions, while adventurous learners can navigate freely through the browsers and hypermedia networks. Systematic learners can use

pretest facilities and then follow the system's advice regarding the sections of the material to which the learner should pay most attention.

Current development work on the LANCAL system is focusing on implementing the findings of the evaluation studies performed with the marketing and waste management students, enhancing the interface and adding further plug-in interactive components.

Hypertext authoring in Art and Design education

Alan Dyer, Coventry University

My paper describes research carried out at Coventry School of Art and Design (Coventry University) over the past eight years. The paper presents a rationale for the potential of hypertext based authoring techniques in the context of art and design education. 'Appropriateness' is demonstrated through specific features of art and design theory and practice.

Firstly, processes involving the disruption of pictorial and spatial convention which have been fundamental to the development of modernism are introduced as a background for the special deconstructive features of hypertext software. Secondly, hypertext is a malleable, fluid medium which lends itself to the creative and lateral thinking methodologies which are fundamental to art and design practice.

A range of prototype hypertext based documents will be described (with illustrations) showing examples of the range of authoring techniques examined during the research period. Examples of the application of hypertext authoring in the context of interactive document design and fine art are production will be shown and described.

The paper will then focus on my own specialist field - the psychology of art and design. My own research and teaching involves the application of pictorial and spatial constructions and metaphors to text based documents. In art and design education at BA and postgraduate levels students have to engage in theoretical/ historical studies. Essays and theses have to be produced. These usually employ methodologies drawn from other disciplines - humanities, social sciences - whose authoring techniques might be alien to art and design practice. The research work described in this paper examines the feasibility of allowing art and design practitioners to engage in text based research while still employing methodologies which are appropriate to familiar studio and workshop based practice.

Research at Coventry suggests that the special interactive and multi-routing features of hypertext software are ideal for theoretical research presentation in the context of art and design education.

The paper will raise some basic issues relating to authorship and 'ownership' of knowledge, author/reader relationships and the problems which arise when interactive documents have to be examined. It will also question the future impact of networking and multiple-authoring systems on knowledge ownership in an educational context.

Evaluation of student perceptions of a computer based laboratory simulation

N S Edward, The Robert Gordon University, Aberdeen

At last year's ALT Conference I reported on the development and production of a multiple media substitute for laboratory experimentation in an undergraduate engineering course. Since then I have evaluated a package which simulates a centrifugal pump lab by piloting it with students divided into two groups one of which used the computer based simulation (CBS) and the other followed the conventional route.

Evaluation included pre and post tests, summative assessment marks, student questionnaires from all participants and selective audio taped semi-structured interviews.

The factors investigated can be broadly grouped into three categories: achievement of learning outcomes, motivation and support, and the user interface. The paper concentrates on student reactions to the simulation itself. It covers dimensions such as the attractiveness of screen presentation, how well it aids visualising the actual plant, the suitability of the length of the program and its ease of use. Perceptions of the computer simulation were found to be related to student perceptions of other elements of the package. Theory was covered in depth in a workbook. Some students had used this

thoroughly while others sought only information they regarded as vital to the lab. The effectiveness of the simulation was highest with the former group.

Students generally approved of the amount of interaction provided in the simulation. Some would, however, have preferred more of the theory than the outline included to have been provided in the CBS. This could easily be added using a Hypertext type of approach. Some students felt that there was insufficient on-screen help and it is planned to enhance this. Students generally felt that simulation was a suitable alternative to labs but they generally also felt that they would miss the essential practical experience given by lab work.

An extensive survey of literature on the practice and evaluation of CAL and CBS and my findings are cross related in an evaluation of the advantages and limitations of CBS. Many other workers felt that CBS could only be effective as part of a varied teaching programme which includes tutor support. Our objective was to provide a free standing package for individual part-time students who miss laboratories. I conclude that we have achieved the optimum which could be expected, but that the experience does not fully match the desired outcomes of laboratory work.

The need for, and the development of, student managed support software

Peter Edwards, Bournemouth University

The guarantee of homogeneity of the academic background of any cohort of students following an undergraduate course is no longer assured. Widening access is one of the contributory factors which, together with others, has complicated the teaching and learning process to such an extent that Foundation Courses and extended degrees are now almost *de rigueur* for some undergraduate programmes. However, these in themselves cannot guarantee that the students knowledge base is made sound.

With restrictions on teaching-staff availability and teaching time, recourse has to be made to supplementary student-managed materials including software packages, of which there is no shortage in terms of that commercially available. However, no two courses are ever the same and tailor-made packages are hard to find. It is no surprise, therefore, to find some university departments producing student material in-house to try to ensure total compatibility between the requirements of a course and the knowledge-base of its students.

This presentation describes how first-year students of the Department of Product Design and Manufacture at Bournemouth University are identified for extra mathematical provision and discusses the rationale behind deciding the contents, and mode of delivery, of relevant support material. It further discusses how appropriate support software can be produced, using Visual Basic, in a relatively short time - software that takes full advantage of the widely known Windows user interface. A demonstration of such software will form an integral part of the presentation.

SHAPE: a semantic-hypermedia authoring program for education

G J Elliott, Eleri Jones & A Cooke, Cardiff Institute of Higher Education and P Barker, Teesside University

There is considerable similarity between concept maps (as a means of knowledge representation) and hypermedia structures (for knowledge emulation). The similarity is even closer when considering hypermedia that is designed deliberately to reflect the underlying structural knowledge of a domain, that is, semantic-hypermedia. Each of the above two modelling techniques represents knowledge domains diagrammatically using graph structures that involve a set of nodes that are connected together by means of labelled and directed arcs. It should be possible therefore to use concept mapping tools to help authors create semantic-hypermedia material and to help reduce the cognitive overhead of expressing a knowledge domain at the same time as they are authoring.

Obviously, the expressiveness of a concept mapping tool that is used for hypermedia authoring must be sufficient to reflect the comprehensive range of educational hypermedia structures that developers might wish to produce. Such a tool must be easy to use but, at the same time, it must not lose any of its abilities to express complex knowledge domains in ways that developers would want to. Given that this is the

case, a potential developer should be able to use a concept mapping tool in order to create, explore and extend a knowledge domain of interest; then, by means of a suitable 'post-processing' system the resultant model could be compiled into an appropriate skeletal hypermedia knowledge corpus. Because of the potential that it offers for providing easy to use hypermedia authoring facilities, we have been exploring the use of concept mapping as an 'up-front' development tool.

This paper is intended to fulfil three objectives. First, it reviews the functionality of concept mapping tools. Second, it identifies some of those other desirable features of such tools which would assist in the development of educationally effective hypermedia authoring - and which would reduce the cognitive overhead for potential developers. Third, it concludes with a specification for our proposed SHAPE system.

Cooperative cross-platform courseware development: email for all - student access to electronic mail at the University of Edinburgh

Jeff Haywood, Hamish Macleod, Brian Gilmore and Christine Rees, University of Edinburgh

During the 1994/95 academic year, the University of Edinburgh has extended electronic mail access to all undergraduate and postgraduate students. This access has been established as a key element of the University's Information Technology (IT) Literacy Programme, and is based on extensive policy deliberations and on empirical pilot projects in two of the University's smaller faculties over the previous academic year.

While email has been in widespread use within traditional computer-using domains (like Computer Science and Artificial Intelligence) for many years, computer-mediated communication provides opportunities which can be exploited within any academic discipline. Access for the students in those departments and faculties without file servers of their own is provided by the University Computing Service on four Novell servers, and the mail-reader package chosen is Pegasus Mail. Pegasus is public domain software which exists in versions for DOS, Microsoft Windows and the Macintosh, with an easy-to-use interface. All of these characteristics make it an ideal vehicle for a large and heterogeneous institution.

Email use represents an intrinsically motivating activity with which students have been quick to engage, and the media attention given to the "global information superhighway" has provided additional encouragement to become involved. Once this has happened, an email program provides experience of a microcosm of those conceptual skills necessary for the development of sophisticated computer use, thus promoting IT Literacy goals. That all students have access to this communication medium opens novel opportunities, both administrative and pedagogic, for Course Organisers, Directors of Studies and academic support services like the Library.

This paper presents an account of the policy, organisational and technical issues which have arisen during the introduction of 'Electronic Mail for All' at the University of Edinburgh, with data on student uptake and usage patterns. Staff experiences and attitudes are discussed with reference to the developing IT Literacy Programme.

Change management for sustainable educational software

Phil Hobbs and Simon Price, University of Bristol

The TLTP Economics Consortium has recently delivered WinEcon, a computer assisted learning software package covering the whole first year introductory economics degree syllabus. Over the three year life of the project to date, managerial and technical effort has been focused primarily on delivering the software. In a previous paper the authors described their educational project management model, based informally on the commercially orientated PRINCE methodology but adapted in recognition that development is likely to be undertaken cooperatively and in a non-profit setting.

In this paper we extend our model beyond the development phase of a software project to include a framework for the transition from development to a sustainable educational software product. We describe and discuss the economic imperatives for achieving sustainability, the mechanisms which must be set in place prior to completion of the development phase, and the post-development management changes necessary to achieve sustainable educational software.

Experiences of managing curriculum development in a large organisation: tactics can be strategy

Ian Huntley, University of Bristol, and Mark Pettigrew, Sheffield Hallam University

Perceived wisdom in the management of curriculum development says 'Start with the enthusiasts, and then cascade to everyone else.' Very often, of course, this is the only way forward - funds to support curriculum development are severely limited, and only the 'keenies' are willing to expend time and energy which is diverted from other pressing needs.

This paper shows how an IT Strategy *can* be embedded within an overall institutional Strategic Plan - a rare occurrence in itself - using Sheffield Hallam University as an exemplar. Taking the area of learning technology as one instance, it then demonstrates how a judicious mix of tactical bidding mechanisms for project funds - open bids (for staff to support areas of personal interest), focused bids (where the areas of interest are defined but the project itself is open), and strategic bids (where the area *and* the project are both specified centrally) - can lead to a strategic implementation plan which both staff *and* management can support.

Changing the role of tutors in distance education with information and communications technologies

Adrian Kirkwood, Ann Jones and Anne Jelfs, The Open University

Although there has been a significant growth in the number of distance education students, courses and institutions in recent years, there remains a major concern that the opportunities for learners to interact with their tutors and fellow students are limited. While working predominantly by themselves, students may have infrequent access to a tutor face-to-face (at a more or less formal tutorial session), by telephone (to discuss problems and queries) and by post (to submit assignments and to receive comments on assignments from the tutor). Contacts between students have tended to be confined to infrequent tutorial sessions and/or self-help groups and occasional telephone conversations.

Recent advances in information and communications technologies have created possibilities for increased interaction and dialogue within distance education, but to date the introduction of new communications systems have tended to be confined to a small selection of courses or to students in certain restricted circumstances. The largely positive outcomes from these relatively limited projects have led to proposals and plans being made to make much greater use of information and communications technologies in distance education. However, scaling-up these activities will have implications for the organisation and operation of distance teaching institutions that have greater significance than anticipated.

The Open University currently has over 200,000 students and 7,500 tutors spread throughout the UK and the EC. There are plans to make more extensive use of information and communications technologies for distance teaching and learning and for administrative contacts between students, tutors and the University's headquarters.

This presentation will report on a study which aims to examine the impact of these proposals on the Tuition and Counselling (TAC) staff, most of whom work only part-time for the Open University. The research will establish the extent to which TAC staff currently have access to and familiarity with information and communications technologies and their perceived needs for training and other forms of support for its effective use. The study also explores the attitudes of TAC staff to the greater use of new technologies in their OU activities and the organisational and pedagogic changes that may ensue.

Replacement of traditional lectures with computer based tutorials: a case study

Derek Lavelle, University of Northumbria at Newcastle

This paper describes an experiment in replacing two traditional lectures with a computer based tutorial. The experiment takes place against a background, in the authors' institution, of a growing trend towards 'computer assisted education', a policy of reducing class contact hours and an expectation upon students to engage in a higher proportion of independent learning.

Windows Help Author is used to create a set of tutorial files on the subject of payment under standard forms of contract in the construction industry. The computer based material deliberately replicates that which would have been available via the traditional lecture approach in order to effect a comparison between the two. The student group studied other aspects of forms of contract via traditional lectures during the course.

The student group undertaking the study provide feedback on the timing and location of the study, the ease of use and perceived flexibility of the computer based material and their preferred mode of study in comparison with a traditional lecture. The opinions expressed were very positive with regard to the ease of use and flexibility of the computer based material. The group were strongly in favour of more of this type of study being incorporated in their course, while retaining a preference for a mixture of lecture and computer based delivery as opposed to a complete changeover to an electronic mode of study.

The lecturers observations of the study are concerned with the overall process of delivery and the learning environment in which the students undertook the computer based study. Recommendations are made on the style and content of computer based material, on the facilities provided for students in which to undertake their learning and on the issue of enhancing vs replacing traditional teaching.

Beyond the multiple choice: six years experience of computer aided assessment in the Earth Sciences, and its implications for the future

Don Mackenzie and Helen Wilkins, University of Derby

Computer aided assessments have been used in the Division of Earth Sciences at the University of Derby since 1989. The Division currently uses six computer aided assessments which have partially replaced traditional course work assessments in degree courses. Student have found little difficulty in adapting to this assessment.

Whilst many of our early assessments were based on multiple choice questions, newer additions to these assessments involve more sophisticated scoring and a greater variety of interaction types in order to avoid guesswork and test understanding as well as factual knowledge. Some tests mimic traditionally practised exercises, as in the case of the 'Screen Microscope', which encompasses most of the facilities of the standard petrological microscope but displayed on the computer screen and forming an integral part of the assessment, so that students may use it in the same way, as they would a standard microscope when answering questions.

All assessments are run by a fully configurable 'Assessment Engine' which handled sequencing of questions, scoring and filing of results. Options to allow re-answering of questions and cycling through the assessment, to ensure that all answers are correct and also available to the tutor.

The use of computer aided assessment in place of a traditional essay type assignment allows the testing of a much wider range of topics and, for student group sizes of around 150, it can result in the saving of about 1 man-week of continuous marking time.

Our experience has shown that computer-aided assessments enhance quality and efficiency and facilitate the quality control of courses. They are popular with students who view them as fair and appreciate the quality control of courses. We are therefore optimistic for the future of computer assessment and anticipate their more widespread implementation.

The scalability of online courses

Robin Mason, The Open University

A good number of institutions worldwide already use computer conferencing as one element of their course provision. Sometimes the on-line interactions are an enhancement to a preexisting course taught either through distance or face-to-face education. Sometimes they constitute the major content of the course and a print component is merely a supplement to the discussions. One of the many advantages of this medium is often said to be that it facilitates the increase of student numbers without a commensurate increase in teaching staff. In these times of shrinking resources and growing

pressure to attract more students, computer conferencing is often regarded as a way of maintaining educational quality while increasing student numbers.

By what sleight of hand is this magic brought about? To some extent the extra ingredient is the other students - that vast untapped resource in higher education. Most computer conferencing courses involve collaborative activities in which students interact with each other and the teacher or tutor is simply a facilitator. Another factor is the flexibility of the medium, such that faculty can work in odd periods of free time, either at home or at work. Consequently, teaching on-line does not appear to make specific up-front demands on the tutor's timetable. Finally, conferences are more efficient than email or the telephone because a message or instruction given once is read by everyone.

Despite these advantages, however, computer conferencing is a time consuming medium and some researchers and practitioners are beginning to question the extent to which student numbers can be increased. Many applications have been drawing on the goodwill and enthusiasm of staff and the novelty of the medium.

This talk will focus on the issue of student to teacher ratios on courses using computer conferencing in a range of different contexts: mass distance education, professional updating courses, internationally-based courses and extensions to campus-based courses. It will try to unravel the conflicting evidence about the scalability of this medium.

A rationale for the development of personal transferable skills through the use of IT in teaching and learning

Audrey McCartan, University of Durham, and Catherine Hare, University of Northumbria at Newcastle

The ITTI Skills Levels Project 11 at the University of Durham, conducted a nationwide consultation and collaboration exercise to identify core IT skills and to develop an approach to IT training capable of meeting these needs.

The report indicated that there was unanimous support for a more structured approach to IT training, including the need for institutional commitment at the highest level and coordination of IT training within an institution's development strategies. A number of external and internal factors has influenced the development and implementation of these IT training and development programmes.

The changing organisation of higher education, including increasing access by non-traditional students, together with a diminishing unit of resource, means that there is a growing recognition of the urgent need to exploit the use of technology in the delivery and assessment of teaching and learning.

The developing information needs of industry and commerce means that it is imperative to extend an information skills programme to allow all students to acquire these skills and to capitalise on the growing importance of networked information resources both for use in their academic work and later on in employment.

A survey of 500 large employers represented by the Association of Graduate Recruiters has indicated that some specific skills are in short supply and that 'personal transferable skills have assumed increased importance in graduate recruitment'.

It is no longer appropriate or efficient to consider the role and benefits of an IT skills programme solely in terms of the acquisition of IT skills. Whilst these are, themselves, transferable skills, it is timely to consider how these established programmes can best be used as a delivery medium through which to teach additional personal transferable skills. Examples might include the integration of IT skills in the preparation of a group presentation or peer group tutoring on the use of electronic information sources within an academic subject. Some institutions have started to address the need for personal transferable skills programmes, particularly in relation to IT skills. Few have considered the staff development needs which would be associated with the implementation of these programmes; few have integrated them within their IT and teaching and learning strategies. Evidence in the Quality in Higher Education Project has strongly supported the importance of assessing quality in terms of the use of core skills, including IT skills, as a mechanism for achieving the personal transferable skills required by employers.

An application of conceptual techniques in education: computer aided ranking of student papers

R V De Mulder and C van Noortwijk, Erasmus University, the Netherlands

In the field of information retrieval there are an increasing number of attempts to build smarter systems using 'conceptual' techniques. With such systems it has become possible to select and to order documents using concepts, rather than just index words or keywords. This development is relevant to education as well, because conceptual techniques can also be used for the assessment of the work of students. This has been done at the Centre for Computers and Law of the Erasmus University. The students hand their assignments in electronic form, after which a computer system is used as an aid to sort these from 'excellent' to 'fail'.

After the introduction, the first section of the paper sets out a definition of the term "concept" and shows how this definition can be refined and operationalized for our specific purpose. A concept is defined as an ordered pair of sets of documents. The conceptual system for assessing assignments is then described. This system is capable of ranking a series of documents according to their relevance to the concept defined by the user. To achieve this, the user (the teacher who is responsible for marking the assignments) has to provide the system with a few example documents. These are previously marked 'A' assignments, possibly supplemented by model assignments. Furthermore, a few counter examples, which are clearly poor assignments, must be identified. The system then calculates a measure for all the documents by comparing the word use in these documents to that of the example and counter example documents, with the help of bayesian statistical techniques. The system has been in use at Erasmus University for over three years now, and has meant a considerable alleviation of the marking workload of teachers. Apart from this, these techniques offer a promise for the future, when student numbers could further increase and more frequent individual feedback will be required.

Changing media : Will a student want to read a printed textbook when an electronic text is available?

Joe Nicholls, Mark Howes and Rick Jones, University of Leeds

The current trend, especially in higher education, is for greater responsibility to be placed on the student, rather than the teacher, to gather and manage learning resources. In parallel, an increasing number of potential resources are being made available in electronic format. Such developments focus attention on the information-seeking skills of students and the appropriateness of retrieval interfaces. For effective transition from paper to electronic media there is a pressing need to examine how readers interact with large expository texts such as textbooks. Current understanding of the psychological processes underlying information retrieval is poor, particularly in the context of complex learning activities.

This paper reports on the behavioural and cognitive activity of learners whilst searching for information using paper and electronic (CD-ROM) versions of a general medical textbook (The Oxford Textbook of Medicine). Medical students used both versions to retrieve information in response to complex, ill-defined questions, typical of those encountered in an educational situation.

Quantitative analysis revealed that the distribution of activity between global access structures and main-body text was very different, with significantly more time spent in the text of the book but in the access structures of the CD-ROM. Think-aloud and verbal protocol analysis were used to identify component cognitive processes accompanying the search activity. Information-seeking strategies were highly dynamic and reactive in response to the information extracted. Domain knowledge played a significant role in determining the specificity of search goals, which strongly influenced subsequent search activity. When using the CD-ROM version, poor domain knowledge led to considerable difficulty in formulating queries, often because the resource did not provide domain information at this time. Contextual information, an important requirement, was found to be more accessible in the book than the CD-ROM.

The implications of this research include the need for a model of information-seeking that achieves an integration of cognition and action, methodological techniques that illuminate this integration, and clear guidelines for designers. Information-seeking

was shown to be highly dynamic, shifting between directed and browse-oriented forms of search. This confirms the need for retrieval tools that support different styles of inquiry in a seamless way.

A new future for situated and collaborative learning and mentorship using the World Wide Web

Michael Nott, Robert Day and Matthew Riddle, University of Melbourne, Australia

The Web is beginning to be used to teach science at the University of Melbourne. Strategies adopted are in response to: student surveys carried out during conventional practical classroom delivery of the materials using printed materials, slides and a computer based simulation; other difficulties perceived by the lecturers; and increasing demands for courses.

Perceptions of the lecturer

An example is 'Population Dynamics' which is a vitally important topic in biology but is usually taught only in small advanced courses. This is because (1) it is difficult to teach, and for the learner to grasp, processes in time and space; (2) populations are abstract, and interact with their environment in complex ways; and (3) the theory cannot be supplemented by 'hands on' examples.

Situating the learning

The use of visual images provides the context for students to build conceptual models. Students have access to a database of animals from mayflies to elephants in their natural habitats. For each animal type a computer simulation, which requires strategic input by the student, presents dynamic processes in a visual way.

Increasing access afforded by the Web

In the past teaching Population Dynamics required a high demonstrator to student ratio and could be taught to only a few students in practical classrooms. The topic is now able to be taught to much larger numbers of students over the University electronic network. It will also be trialled the University of NSW. It will become available to students, over the Web, for home study.

Preferred learning style

Students may learn according to their preferred style. Learning goals and a range of learning options are clearly defined. Students reflect on the material by following a structured learning path from simple examples to the most complex, with important concepts explained; experiment with 'what if?' variations to explore questions about the way populations grow; or manipulate the growth of populations by building their own examples using 'action based' learning.

Moderated Newsgroups for collaborative learning and mentorship

Current theories view learning as an iterative interaction requiring constant feedback; Laurillard states that "Action without feedback is completely unproductive for a learner". In addition to the inherent feedback provided by the simulations, moderated Web Newsgroups allow mentoring and tracking by the tutor, and collaborative learning.

Taking the technocracy out of video technology in higher education

Chris O'Hagan, University of Derby

The Department of Educational Methods and Media at the University of Derby has developed an innovative system which enables teachers to make video programmes without any technical assistance. VESOL, Video autoEditing System for Open Learning, can be fitted into any lecture theatre, and the lecturer can produce a fully edited programme in the same time as it takes to give the lecture. The lecturer switches cameras between himself and other visuals while giving the lecture. There are substantial savings in time and other costs over previous methods of videoing lectures. An installation can cost as little as £8,000.

It is easier to use than a description would suggest. Staff have generally been enthusiastic when introduced to the system, and after initial group training of a hour, can practise as individuals in privacy when the venue is not otherwise in use. The system is currently in intensive use to record undergraduate Psychology lectures, though it will be next Academic year before the materials produced will be in full use by students.

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Experience with the basic system has led to other developments. VELAB, Video Enhanced Laboratory, is in use in the Biology department and as well as producing video records of experiments can also be used to show an experiment to a cohort of students, live, on screens in a neighbouring room. MiniVESOL is being developed for use without a live audience, with a pause capability which will allow a programme to be built in sections by a lecturer. It can be fitted to a cubicle about 2-3 m square and student use is also anticipated.

Programmes can be of almost any length and purpose: eg to replace repeat lecturing, as a library resource, or in distance learning. With VESOL, video comes of age in higher education as an autonomous resource for both teachers and learners.

The basic VESOL system has been described already in other publications. This paper, after a brief overview, will mainly examine the latest developments in the systems, particularly MiniVESOL and progress in using the materials produced. VESOL is part of the TLTP Phase II project.

The use of Hypertext and the World Wide Web in computer based assessment

N Parrington, R I Ferguson and J Mills, University of Sunderland

This paper describes the development of hypertext based assessment materials which have been designed for use in the support of the teaching of software engineering. The system, created in the School of Computing and Information Systems at the University of Sunderland is available via the World-Wide-Web (the Web) and permits assessment to take place on any computer connected to the global academic computer network, the Internet (the Net).

Current practices in assessing Software Engineering at Sunderland are reviewed along with the problems they present such as high staff/student ratios and low contact time between staff and individual students. The assessment materials are discussed and the rationale for the development of the new system presented.

'State-of-the-art' networking technology has been used for the preparation and delivery of the new assessment system. A review of the enabling technology and reasons for its adoption is given as well as a description of the finished delivery system and an account its development

Several features of the Web make it an ideal medium for the support of computer based assessment. Features such as electronic submission of work and automated delivery of results can be used to counteract the effects of reduced contact time.

The system, which is based on the multi choice question (MCQ) technique, facilitates automatic setting and marking of formative questionnaires as well as permitting automatic marking of summative tests. One of the advanced features of the system is its ability to deliver CASE tool usage over the Web. The reasons for doing this and the methods underlying it are discussed.

The system 'goes live' in the 94/95 academic year. The use of the open-learning paradigm will lead to greater quality in the delivering of material to students. The use of global hypertext allows the easy construction of material for student centred learning whilst on line CASE tools and tutorial exercises together with automatic marking be beneficial for courses run in distance learning modes

Based on Oracle backplane, the system allows lecturers to set up and maintain databases of questions and facilitates the easy construction of tests within or across disciplines. The paper discusses the implications of automated computer-based assessment on current teaching and learning practices.

Shrink-wrapped solutions aren't

Mark Pettigrew, Sheffield Hallam University and Ian Huntley, University of Bristol

"Everything you need to create dynamic multimedia applications is in this box."

"Whether you're developing interactive learning courseware for education and training, performance support systems, information kiosks, CD-ROM titles, or hypertext references. Multimedia IconToolWare® gives you all the tools you need to develop effective, interactive Windows® multimedia applications. With Multimedia IconToolWare®, authoring has become more powerful, more efficient, and easier to use than ever."

For many involved in education, the attraction of packages like this is that on the face of it they appear to allow a user to develop computer-based learning resources by using something like a multimedia word-processor. The reality is, however, very different. Novices are faced with a highly flexible but bewildering array of discrete tools, designed to carry out atomic components of the daunting task of assembling a multimedia learning resource.

Little effective support is given in these shrink-wrapped packages for the design and development of usable and effective computer-based learning resources. Teaching staff often think they want to learn the skills to produce computer-based learning resources be themselves from scratch, but this is generally neither practical nor effective, especially in a time of contracting resources. As educational establishments we cannot afford to provide this kind of widespread support at the low level indicated by the shrink-wrapped package. Instead, we need to look at the use of productivity tools and approaches to development which take the responsibility for handling low-level code and objects away from the individual developer.

The paper discusses the issues involved in developing effective learning resources from scratch, and looks at the use of add-on tools and templates to provide increased productivity, usability and reliability. These tools and templates can:

- cut down on wasted time and the agony of developing from scratch.
- produce a more reliable resource whilst at the same time reducing development.
- provide a standardised route to course administration and reporting.
- remove or reduce the need for extensive user testing.

WinEcon lecturer: an innovative course management system

Simon Price, Li Lin Cheah and Jasper Tredgold, University of Bristol

All too frequently computer assisted learning (CAL) software is inflexible and prescriptive. Lecturers attracted to the software by the lure of efficiency gains and improvements in teaching quality are forced to adopt both the software and its entire pedagogic structure. This pedagogic imperialism extends from the teaching content of the course down to the exact questions students are asked in tests.

In this paper we argue that the inflexible and prescriptive nature of existing CAL software is a major barrier to its uptake by lecturers and institutions and that until this problem is overcome the full benefits can not be attained. We then go on to describe WinEcon Lecturer, the Course Management System which accompanies the WinEcon economics CAL software, and discuss how it addresses these problems by giving lecturers control over several key pedagogic aspects of course delivery. These include:

- Drag and drop course restructuring.
- Editable course titles, chapter titles and section titles.
- Editable introductions and summaries.
- Editable glossary definitions.
- Editable references database.
- Editable questions database.
- Configurable rules for assessments.
- Configurable tests and marking database.
- Configurable audit trail.
- Course presentation option settings.
- Seamless extensibility via lecturer authored WinEcon topics.
- Third party application launcher.

The presentation of the paper will include a demonstration of WinEcon Lecturer working in conjunction with the WinEcon teaching software.

Educational computing systems: exploitation by integration

A Ravenscroft, K Tait and I E Hughes, University of Leeds

To exploit Educational Computing Systems we must design them to integrate with the curricula using a clearly defined, pedagogically directed *modus operandi*. The computer provides an additional learning environment that is not necessarily a replacement for conventional methods (books, lectures, tutorials, etc); it is a powerful resource that

contributes to an appropriate, individually balanced ensemble of experiences acting synergistically to improve teaching and learning.

We have developed a generic lecture support system that integrates the computer-based learning materials which extend and underpin timetabled lecture modules. The system provides 'electronic libraries' that support flexible, independent learning and allow students to engage in novel, interactive and additional learning tasks. Lecturers decide what electronic materials (documents, tutorial packages, simulations, lecture slides) are attached to the lecture slots in an interactive timetable, and hence integrated with their teaching, allowing them to direct and structure the students learning on a day to day basis

Formative evaluations of a Pharmacology Integrated Lecture Support (PILS) system are very promising. Focus group data shows that students are more reflective in lectures: they do not have to translate the 'live' lectures into comprehensive notes as they have the detailed lecture materials (summaries, handouts, lecturers notes, slides) 'at hand' or on-line. In general, the interactive courseware is considered useful to test, extend and consolidate understanding of a topic. The provision of materials through a word processor allows students to annotate, edit and reorganise the materials to form their own, tailor-made electronic or paper-based 'work books'. In Course Evaluation surveys students rated their PILS systems more highly than any other aspect of the course. For example, as a learning aid, the mean ratings given by Medical and Medical Science students (151/153), on a scale of 1 (very poor) to 5 (very good) was 4.27 (SD 0.59) with 44.4% rating it 5, 40.4% rating it 4, and only 2% rating it less than 3.

In summary, by designing for integration with the learning context, we have developed systems that provide a focus for self directed study which are highly valued and used widely and regularly to support a range of teaching and learning styles.

Towards a theory of technological innovation within higher education

Rachael Scott and Brent Robinson, University of Cambridge

Higher education in the UK is currently being subjected to a period of unprecedented change, generating immediate requirements for rethinking teaching and learning strategies. During this time, attention has rightly been addressed to the reasons for change, but as we move from rationale to action, it becomes important to consider carefully the strategies which may be employed to bring about successful innovation.

This paper will draw upon the literature of educational change to present a paradigm for technological innovation in HE in order to illuminate existing practice and inform future policy and action. A theory of change will be contrasted with a theory of changing. In detailing this phenomenological approach the paper will essentially move through three stages:

- 1 Contextualising the paradigm within the present HE milieu by addressing issues of quality, access, accountability, efficiency, economy and government policy.
- 2 Presenting the variables known to affect technological change in HE in the form of a taxonomy, comprising the following three elements:
 - Personal - personality, attitude, leadership, sponsorship
 - Context - location, organisational structure, the learning organisation, training
 - Task - nature of task and specific application
- 3 Distinguishing a theory of change (an awareness of 'what' and 'why') from a theory of changing (an awareness of 'how'). This phase of the presentation will outline strategies compliant with how to implement technology within HE and will cover:
 - Creating a change climate
 - Agents of change
 - Human Resources Management
 - Training, staff development and follow up support
 - Planning, evaluation and revision
 - Total Quality Management

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The use of the Internet in distance learning and continuing professional development for property and construction professionals

Brian Sloan, Napier University, Edinburgh

The proposed paper will consider the potential for the Internet to be used by academic institutions to undertake distance learning, with particular reference to Continuing Professional Development for the property and construction professions.

This paper will discuss the opportunities which exist for the adoption of CAL/CBT techniques within training programmes in property and construction economics and how the Internet might be utilised to assist in meeting this training need. Theoretical aspects of courseware design will be drawn upon and illustrations given of work being undertaken within the Department of Building and Surveying at the Napier University, Edinburgh. The paper will put forward the hypothesis that CAL/CBT and particularly the use of the Internet, offers opportunities for cost-effective training for property and construction professionals.

Video conferencing in medical education: LiveNet at UCL

Sandra Thompson, UCL Medical School

This paper will present the use of LiveNet in the above context and discuss the experience of using videoconferencing technology within the teaching curriculum.

LiveNet has been in use since 1987 as a collaborative project between London University and British Telecom to provide interactive Video teaching for intercollegiate courses held within the University. Since the beginning of the last Academic year (1993/4), LiveNet has been an integral part of the teaching curriculum for Undergraduate Medical students at University College, London.

Students are split between two hospital sites, the Middlesex Hospital in Central London and the Whittington Hospital at Archway, North London. Prior to the installation of LiveNet, students at the Whittington Hospital were required to travel to Central London to attend 3 hour blocks of lectures at least once a week.

Advantages of LiveNet

- Students have access to a greater range of expertise in a wider range of subjects. This is particularly evident with the recent LiveNet link to SuperJANET enabling all UCL Medical Students to partake in the INSURRECT Surgical Teaching Project. This involves six teaching hospitals throughout the UK, using a rotational basis to provide lectures twice a week.
- Consultants are not required to travel in order to deliver a lecture to a greater number of students. This produces a more efficient use of consultants' time.
- Decrease in student travelling time allows for more time on wards.
- Allows students to attend ward activities between lectures, and attend patient emergencies without missing a whole afternoon's lectures.
- Allows increased numbers of students to observe a patient's symptoms within the Lecture room.
- As the operating theatres are also linked to LiveNet, students may observe procedures *en masse* without overcrowding or risk of infection.
- Student presentations over LiveNet familiarises students with the use of new technology, which many feel to be particularly advantageous within the contexts of both clinical presentations and telemedicine.

Problems experienced by the use of LiveNet

- Lecturing style is restricted by the use of the technology.
- Interactivity. The need to make the technology as transparent as possible.
- Image quality. How to transmit images of adequate quality for radiology, pathology, histopathology, surgery.
- Care must be taken with preparation of visual aids to be used with LiveNet.
- Contingency plans must be made to protect against system failure.

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Horses for courses and tools for teachers

Sue Tickner, University of Glasgow

The University of Glasgow's project, *Teaching with Independent Learning Technologies* (TILT) is a TLTP-funded institutional project nearing the end of its three-year lifecycle. One of the aims of the project has been to adapt and apply methods of evaluating learning as a way of improving the integration of IT into Higher Education and to make recommendations based on our findings.

At CAL95 in April we were able to report that our two-years' experience in TILT repeatedly showed the most important factor in the successful implementation and student uptake of CAL in HE is thorough, planned and supported integration with more traditional teaching media. In this, teacher's attitudes and perceptions of the courseware are all-important. One of the barriers to effective integration of products from other initiatives has been labelled the 'not-invented here' syndrome. This is only a part of a broader problem; courseware is usually provided as a self-contained, completed package. In contrast to printed material, which lends itself to cutting, chunking and annotating, teachers do not always see an easy way to combine the new materials with either the existing curriculum, course progression or with their own teaching methods.

It is argued that a greater adaptability in the software will help to remove these barriers and that flexibility of use is the key to widespread integration.

Much criticism is aimed at tutorial packages, but in a subject-area such as data-analysis a self-access tutorial and practise program can provide many benefits, particularly when the software can be customised for different subject areas.

Some of the ways in which adaptability can be achieved are examined through the capabilities built into 'GraphIT!', a basic data-analysis tutorial package developed by TILT's Numerical Data Group, and the teacher's shell with which it interfaces.

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New directions in computer-based learning for social psychology

Lesley J Allinson, University of Humberside

Perhaps surprisingly, psychology has been a discipline eager to capitalise on the application of computer for teaching. Though generally, in the early days, this was for statistical calculations, and both the presentation of experimental stimuli and the automatic calculation of timed events (eg reaction times, choice decision times, etc). The traditional capabilities of computers were being exploited - namely their accurate temporal sequencing and graphical performance and, above all, their *number crunching*. As such, they have been powerful and essential tools for those involved in the more psychophysical or cognitive areas of psychology. Computer based learning (CBL) remained very much the preserve of the more formal domains.

The arrival of hypermedia, however, opened the way for CBL to be exploited in the more non-formal domains of psychology (and the other behavioural sciences:) but the level of interactivity was usually very restricted and the constrained presentational styles meant that even this technological progression failed to meet the contextual richness needed in the teaching of much of the behavioural sciences. The advent of multimedia, through advances in computing and communication, has for the first time provided the potential to explore, within the standard learning environment, *real* behaviour using the observational techniques that form the basic methodology of the social scientist. The integration of video is not a luxury or a technological *can-do so so must-do*, but an enabling and essential facet for CBL for social psychology. This contribution will start from the current status in multimedia development, illustrate through examples how it will radically transform the presentation and scope of social psychology education, and finally suggest the implications of future technological advances. Issues addressed will include:

- Information needs for, and the essential methodology of, the observational study of human behaviour.
- Current multimedia systems and their integration of experimental material, analysis methods, data manipulation and learning support.
- The merging of research and teaching tools - enabling active learning and promoting the virtual real-world laboratory.

Strategies for using electronic lectures

Phillip Barker, University of Teesside, Ian Benest, University of York, and Terry Anderson, University of Ulster

It is our contention that for some time to come lectures (in one form or another) will continue to play a major role in teaching and learning activities within higher education. But this method of teaching will be strongly influenced by developments in computing, information storage, computer networking and display technologies. Indeed, such resources can be used to improve significantly the quality of conventional lectures and, at the same time provide considerable potential for enhancing the overall quality of students' learning experiences.

Nowadays, increasing use is being made of various types of presentation tool in order to deliver electronic lectures to both small and large groups using a computer system that is attached to an appropriate projection facility. For example, Anderson uses the Microsoft PowerPoint package; copies of his electronic slides are made available to the students in the form of a paper-based course handbook. Similarly, Benest and Hague make use of an *electronic book emulator* to prepare and deliver online lectures. The Book Emulator is a powerful presentation tool that runs on a SUN 3s and Indy workstations. Barker uses a low-cost, easy-to-use packages (ToolBook) running on a multimedia personal computer that is attached to a local area network; copies of his slides are made available electronically through an online database facility to which all students have real access.

Given the above three *scenario* the purpose of this discussion workshop is to identify the important issues, problems, advantages and disadvantages associated with creating and using electronic lectures. It is anticipated that the workshop will provide the opportunity for participants to share their views and to debate strategies for establishing good practice.

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Support for the development and use of learning technology: an institutional case study

Kathy Beedham, Sue Geale, Philip Richards & Richard Heseltine, University of Hull

The Centre for Teaching and Learning support (CLTS) was established in 1994 by the University of Hull to promote quality and innovation in teaching within the institution, with particular reference to learning technology.

This paper will describe how the two Education Technology Advisers and the Networked Information Adviser appointed to the CLTS have set about establishing it as the focal point on campus for the interchange of ideas and knowledge in the field of educational technology. Specific information on the CLTS's network services within the University, its world wide web and electronic mail services available on the internet, meetings and events organised, and other projects will be given.

Developing and international learning community based on Lotus Notes

David Birchall and Elisabeth Houldsworth, Henley Management College

This paper deals with the use of technology, notably Lotus Notes, for the development of a Doctoral Programme and establishment of a Networked International Learning Community.

The first section describes the background context, which includes a brief overview of the nature of the Doctoral Programme within the context of a rapidly internationalising business school. The programme has in excess of 200 students, mostly part-time, in 22 countries with centralised administration and delivery in three centres: Henley, Grenoble and Singapore who provide workshops including residential modules.

The particular needs of the Programme members and tutors are:

- a cost effective support system
- access to information to support research
- access to peers and tutors internationally, free of constraints of time and place.

Henley has had experience in the use of computer mediated communications since 1988 and adopted Lotus Notes in 1994. Facilities and services include:

- email between tutors/administrative staff/students
- subject specific conferences
- cohort specific mentoring conferences
- research conferences on topics such as methodology
- structured delivery of a workshop source material with related tutoring
- access to Working Papers and Reports
- workshop information and booking facilities
- electronic transfer of submission documents

The authors discuss how the adoption of this technology impacts upon the teaching of the business school, the design of the programme and the long term strategy for delivery of international programmes. This draws on a survey of Lotus Notes users from both students and staff as well as results from a survey of management researchers and their perceived information needs - both of which highlight the importance of the immediacy and relevance of feedback, communication and information.

In the future Henley envisages further development to produce an integrated support system to provide research tools, database access, mentoring and tutoring, as well as peer group support and debate.

The use of spreadsheet software for assisting learning & assessment: an Australian experience

Paul Blayney, University of Sydney

This paper describes the development of a spreadsheet-based computer marking system and its use in first and second year accounting courses at the University of Sydney in 1994 and 1995. A live demonstration of the system is conducted as an integral part of the paper.

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The paper begins with a relatively brief depiction of the two-fold motivation for the development:

- 1 the desire to provide large numbers of students with accurate / reliable feedback on assignments in a resource constrained environment and
- 2 to foster use of the personal computer as a problem solving tool and for students to begin to develop expertise with a computer spreadsheet.

The first motivation above is in essence an integral part of one institution's changing strategy to deal with both the current economic environment and the needs of applicability of the system - that it can be used with equal effectiveness in disciplines other than accounting.

The paper concludes with a summary of the experience at the University of Sydney in 1994 and 1995. A description of the experience at this institution with alternate assessment mechanisms is described together with the results of a survey of students involved in the exercise. The paper concludes with an analysis of students' participation and success in the course's computer component (frequency, timing and quality of assignment submissions) and their overall performance in the course.

The information technology explosion in HE: are we beguiled?

S C Busbridge, M G Cornwall & J Southern, University of Brighton

At the University of Brighton we are running a pilot study to assess the effectiveness of *electronic* course delivery in undergraduate Physics courses. The concept of *electronic* course delivery can be thought of as encouraging the culture of information exchange through computer technology and the development of a personal, multimedia encyclopaedia, and as such represents the course delivery method of the future for science in general at Brighton.

As part of the implementation of the pilot, staff and students are actively engaged in practical teaching and learning through each of the following computer technologies:

- computer mediated communication
- the Internet and World Wide Web
- courseware
- computer algebra packages
- interfacing and simulation
- databases
- dissemination, distance learning and telematics
- virtual reality
- course management

Although the course team is convinced of the increased flexibility of such a technology-driven course, we are aware of the "technodazzle" effect, by which new technology is almost automatically adopted, apparently without a prior analysis of its educational merit. This paper discusses the education objectives of each of the above technologies, in the context of science courses, from the perspectives of both students and staff.

We conclude that computer technology should be used in preference to more traditional technologies only when the objectives have been thoroughly investigated. For example, there is not yet sufficient evidence to suggest that hypertext and printer is a more effective learning tool than text book, pencil and paper. We end on a cautiously optimistic note, and highlight those areas of the technology where we see distinct advantages for scientific teaching and learning.

Learning and living with technology

Phillip Butcher, Open University

This paper will chart the introduction of computers, and the learning opportunities that computers provide, on one, rather large, Open University course. From tentative beginnings the use of the computer is now so widespread throughout the course that it is no longer treated as something novel and different. Instead it is seen as a tool to be used as and when appropriate. This course is the Open University Technology Facul-

ty's foundation course, T102: Living with technology, which has over 4,000 students each year.

A decade has passed since the idea of introducing computers into Living with technology was first mooted but the underlying rationale is as strong in the mid-90's as it was in the mid-80's. Put very briefly the rationale had two main themes. Firstly that in the late 20th century the computer is a tool of the modern technologist's trade (spread-sheet modelling and graphing, CAD etc) and secondly with a computer in the student's home we have a powerful learning aid. One other overriding consideration was that whatever was done must have a pay-off. If we were expecting the student to invest time and money in learning to use the technology then we should deliver efficiencies to offset the students' investment.

I shall argue that it is this well founded rationale that has sustained computing in Living with technology through rewrites which have seen more than 50% of the course being rewritten by three disparate groups of academics. With each rewrite more computer based applications have been provided. At a facile level we can record that the volume of software dispatched to students has increased by 70% since the computer was first introduced in 1989.

In 1996 the computing component of Living with technology will encompass teaching the use of an integrated package using that package for solving problems and submitting assignments. CAL software associated with five (out of six) blocks of the course: CAD and modelling software: email and conferencing: an online library of up-to-date references.

New approaches to the learning environment at the University of Bradford

Alan Carling, Lynda Prescott and Lawrence Hamburg, University of Bradford

Amongst the courses followed by first-year students in the Department of Interdisciplinary Human Studies at the University of Bradford are modules in sociology, social statistics, and literature. During the second semester of 1994-95 new approaches were introduced in these three areas. The main impetus for change was the increase in student numbers and consequent straining of traditional teaching methods. The means for change involved several factors:

- the University's investment in computer technology;
- the existence of a Teaching and Learning Development Unit, part of whose remit is to foster teaching innovations; and
- a commitment to student-centred learning on the part of academic staff.

In the area of social statistics, the materials for the half-module course were centred on an interactive computer-assisted learning resource (developed using Question Mark Designer for Windows and including multimedia calls). In previous years, delivery was based on six one hour lectures; these are now replaced by brief introductory lectures to the six supported workshop sessions (as the resource is refined, these introductory lectures may not be required). Final assessment is assignment based, covering areas used in all six workshops.

One of the new developments in literature and sociology also used the supervised workshop model; in this case the material was a multimedia resource (developed in Authorware Professional) built around the 1936 GPO film *Night Mail*. Students arrived at these workshops halfway through their linked modules in literature and sociology. The interactive *Night Mail* resource was presented as an interdisciplinary case-study approached via the conventional lecture-and-tutorial route offering views of British society and arts in the 1930s. The resource also acted as a springboard for possible projects by individual students or small groups in a related interdisciplinary module.

The third new development was tutorials conducted through electronic mail. These were designed to encourage cumulative exchange of ideas between students in a way that released tutors to respond to individual enquiries arising from the module material and, where appropriate, to develop discussion from students, reflections on the material.

The three papers offered in this workshop describe the rationale for these particular new approaches to the learning environment, the practicalities of their development, introduction and delivery, and an account of their evaluation.

Changing teaching - staff development and new technology

Robina Clayphan, University of Durham

Over the past decade Universities have devoted considerable time, effort and money to providing IT training for staff and students. To a large extent these were seen as a stand alone group of skills that could be used as a tool in academic work and provided a body of transferable skills for future employment.

To capitalise on this investment the next step is to integrate IT into teaching and learning in several ways - as a tool to deliver instruction, to assist in the management of learning and for communications. Two conclusions are becoming apparent on TLTP Project 45 - *Core IT Skills for Teaching and Learning: Tools for the Development of a National Framework*:

- 1 the urgent need for staff development to exploit the capabilities of new technology fully, not simply as tools, but as part of a new approach to teaching and learning;
- 2 the need for an institutional level teaching and learning policy to ensure all departments undertake the required developments.

An examination of the prevailing situation in Higher Education indicates the validity of these conclusions:

- *External pressures* - increasing student numbers: the reducing unit of resource: the demand for accountability.
- *Environmental changes* - the growth of the network in the world at large: the development of the technical infrastructure in universities: the expectations of employers.

The unambiguous steer provided by the HEFCs - succeeding initiatives (ITTI, TLTP etc) have promoted the development of courseware, and the new Teaching Quality Assessment Method. All six of the heads which will count towards the assessment contain elements that either explicitly refer to IT or do so indirectly by reference to innovation in teaching, generic skills, etc.

Future scenarios of higher education and their implications for learning technologies and the nature of universities in the new millennium

Susan Clayton, Open University

Modern multimedia and modern electronic communication systems could radically alter the face of higher education and its role in society. The paper identifies some possible long-term future scenarios for higher education arising from these changes, together with those occurring as a consequence of the effect of modern electronic communication systems on many other facets of social, economic and political life.

The paper considers the possible consequences of these developments and seeks to analyse how different assumptions about the nature of higher education in the next millennium affect current thinking about education and learning. The scenarios considered in the paper range from the maintenance of the status quo, through the development of an integrated global university, to the total demise of higher education institutions as currently conceived. Having identified a diversity of scenarios the paper then discusses their possible implications for contemporary planning of learning technologies and the development of new partnerships in higher education.

Issues discussed include collaboration in the development of courseware and learning technologies aimed at local, national and world audiences; choices for students in the style, place, timing and cost of their studies; electronic communication between students, tutors and external communities; diversity in approaches to assessment; the impact of study across international and cultural boundaries; the expertise required by university staff; requirements for teaching and student accommodation; new approaches to academic discourse and provision of sex, drugs and rock-and-roll; changes in the nature and status of vocational training; new relationships with government,

commercial organisations, employers, local and international communities; differentiation between institutions and division of responsibilities for teaching, assessment and accreditation; the impact of economic and social change on life-long learning; redirection of the goals of education and changes in the role and status of higher education in society.

It is not possible to foresee the future of higher education. However, it is likely that the future will be influenced by the extent to which Universities seek to influence their destiny and the approaches they adopt to meeting the changing world in which they operate. The paper concludes by arguing that analysis of possible future scenarios is a valuable tool for helping Universities develop their long-term strategic objectives and for making wise, short-term decisions about the development of learning technologies.

A tutorial system to support the teaching of fluid mechanics

R Creasey, G J Blyth, R O Augood, T David and I M Goodwill, University of Leeds

The need to admit ever increasing student numbers, coupled with restrictions on budgets within Higher Education, has led to increased student: lecturer ratio. It also means that many students enter University engineering courses with little or no previous experience of applied mathematics.

To promote student-centred learning while at the same time attempting to compensate for the reduction in the amount of time that lecturers can devote to students, Leeds University Faculty of Engineering decided to create CAL tutorials in fluid mechanics. The project team comprised teaching staff, a programmer and computing support staff. One aim of the project was to provide a system whereby staff could easily input and maintain material independently.

The tutorials were written using Microsoft Excel5. This was chosen as the preferred development tool because it enabled the tutorial to be delivered via the University network, required little learning by the programmer and because it allowed for the use of Excel's spreadsheet capabilities and Visual Basic for Applications. There is also potential for linking to other Windows applications.

The tutorial takes the form of worked examples and includes elements describing a generic problem solving methodology, a dictionary of engineering terms, an equation book and a calculator. These specific examples were chosen for the tutorial because:

- The aim was to provide generic solutions which could be adapted for specific problems within the same field.
- The project was a collaborative venture between the departments of civil and mechanical engineering.

Students are prompted for input in the creation of mathematical models, the steps required for solving the problems, and what principles are used. Students are also required to perform mathematical tasks, sometimes by way of multiple choice questions (eg when evaluating an integration) and at other times by directly inputting a calculated value.

Currently student usage is monitored to see the amount of time spent on the tutorial and whether the tutorial was completed or abandoned. The first version of the tutorial has been installed on the University computing network and trials of the package have been carried out on first year students. Feedback has so far been overwhelmingly positive.

The University of Leeds CAD teaching project

R Creasey, A M Smith, and A S Watson, University of Leeds

The University of Leeds is using a bespoke online teaching package developed in-house to introduce over two hundred students to the use of Computer Aided Design. The package runs along side the target CAD system and delivers structured tutorials.

For historical reasons the teaching package is running under the UNIX operating system on Sun workstations, using AutoCAD R12 and an authoring package FrameMaker/FrameViewer, which allows the use of hypertext links between documents. The teaching material itself has been written in such a way that it could easily be transferred to other platforms and used with a different authoring package.

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The tutorial has been used since October 1994 with students from the departments of Civil and Mining and Mineral Engineering. Initial responses have been good and the feedback from both the staff and student has been constructive, allowing on going improvements to be made.

The usage of the package by individual students is being monitored. The data obtained will provide information to the academic staff to assist in the assessment of the student's CAD competence.

The monitoring will make it possible to detect at an early stage students who are having difficulty with the CAD course, thus allowing the lecturer to target individual students and supply appropriate guidance.

This package allows students to work outside of the scheduled CAD teaching sessions and hence makes maximum use of scarce computing resources. At the same time it reduces teaching staff contact time while enabling them to provide appropriate individual learning support.

Designing systems for changing higher education

Jonathan Darby, University of Oxford

Higher education is going to be under increasing pressure to change over the next five years. This is due to changes in the number and nature of the student population, changed expectations and demands, changes in resource availability, changes in the job market and increased international competition. Present planning systems in higher education institutions are unlikely to be able to successfully manage this change.

Similar situations of rapid change exist in other sectors such as health and local government. ICL are a company with considerable experience of facilitating change through the introduction of new computer systems. In recent years they have sought to document their experience, and that of their clients, through their OPENframework™ publications. In March 1995 they established a working party to examine higher education. The work of this group will culminate at the end of 1995 with the publication of "A method for managing change in higher education". This report will particularly focus on systems for introducing and managing learning technology.

The presentation will summarise the work of the group to date and invite discussion on the approach being advocated for managing change.

Using computer-assisted learning courseware to support the teaching of fieldwork skills

Bryan Dawson and Simon Heath, University of Aberdeen; Ian Bradley, Silsoe College, Donald Davidson, University of Stirling; David Dent, University of East Anglia; Stephen Nortcliff, University of Reading; and Robert Shiel, University of Newcastle upon Tyne

Fieldwork is an expensive but essential component of many courses, so it is vital that maximum value be derived from the investment. Anything that can help to make a field course more effective increases the value of the field experience. In many specialist areas, field courses have disappeared or are under threat, largely because of their cost, with the result that future students may not have the opportunity to gain practical experience in the field. The better the students are prepared for their fieldwork the more they will gain from the fieldwork experience.

A computer-assisted learning (CAL) program can be a particularly effective method of presenting students with a visual representation of a landscape, and providing the computer equivalent of the tools they will use in the field. With appropriate exercises, the student can develop skills and strategies on the computer that will subsequently be employed in the field. As with all simulation modelling, a computer fieldwork simulation allows mistakes to be easily rectified and the exercises repeated at low cost.

This paper examines the design and development processes for one such CAL program, Soil Surveyor, which is aimed at introducing students of Soil Science and Environmental Science to the techniques and problems involved in the field mapping of soils. The program has two main functions: to display the visual resources that would be used by the field surveyor, and to synthesise data for the soil at any point in the study area.

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The program, which is written in Visual C++ for the Windows PC environment contains many innovations. Those developed in detail include:

- The ability to sample the landscape at any point in the study area.
- The use of hypergraphically-linked photographs and maps to provide alternative views of the landscape.
- The control of the data synthesis by a spreadsheet,
- The removal of all site-specific data from the program, allowing other datasets to be readily substituted.
- The use of a Wizard to control program configuration.

The creation of the visual resources database, and the means of introducing realism into the program are discussed, together with the results of initial evaluation of the package in use.

Producing, evaluating and delivering CAL using a semi-formal support network with low-risk investment for each partner

G F Doughty and members of the TILT Project, University of Glasgow

The University of Glasgow's institutional TLTP project, *Teaching with Independent Learning Technologies* (TILT), has been investigating different ways of organising the production, evaluation and delivery of CAL. Throughout the UK, methods range from the lone worker making a simple package, through a teacher's application of an institutionally-devised or supported software shell, to setting up a team of specialists for package development, with members residing mainly together in a department, or in a centrally-funded hyper/multimedia unit. None of these organisational arrangements are free of potential disadvantages, varying from inadequate skills and resources, through lack of academic freedom, to the tendency for a specialist unit to eventually need to seek its own funds by working for high-paying commercial outsiders rather than needy internal learners.

TILT has adopted the approach of employing a wide range of expertise, but not as a centrally-located team. We have generally located a single expert in each participating department, and arranged for these experts in different aspects of the process to help each other as necessary, working in a semi-formal support network. Each has their priority and loyalty to their host department's needs, but can draw on a wide range of skills. No single department or a central service incurs a large initial investment. Using examples of packages produced for a variety of subject areas we argue that this approach is fruitful, cost-effective and low-risk, and can continue as an institutional funding method for package production after TLTP is over.

Technology and open learning management education: competence, learner control and the new media

John Eldred, Kingston Business School

This proposal examines the impact of recent developments in network and multimedia technologies on the design and delivery of open and distance learning management development courses. The proposal reviews how these technologies can be used to achieve effective support and learning for open/distance learning students. The paper argues that these technologies will have a dramatic effect on the philosophy, culture and effectiveness of distance learning courses and explores the critical decisions that need to be taken by educationalists involved in developing distance education, electronic communication, multimedia and hypertext. The paper argues that the recent restructuring of management education to embrace competence based approaches, development in the context of the work environment and the learning organisation are all leading to an increased need to adopt networking technologies and multimedia delivery systems.

The background to this proposal is the research and developments that have been implemented over the last five years on a distance learning postgraduate, post-experience management development course (Diploma in Management Studies). The paper discusses some of the design issues that need to be addressed to ensure effective course development using different media and the implications for the students in terms of support, control and the learning environment. The proposal focuses on the

two core technologies of networked communication systems (The Internet, email and associated bulletin boards, discussion groups and conferencing software) and multimedia authoring systems. The proposal addresses the following key issues:

- What are the new educational issues associated with developing distance education packages for the junior and middle manager where the pedagogical and learning goals have embraced the competence framework of management development?
- How can we improve the way in which we use The Internet, electronic mail and networks for communication and student support?
- What are the issues associated with the integration of multimedia and hypermedia systems into distance education for the middle manager?

These issues are examined in the context of the development and trial of new approaches to support and delivery and student evaluation of the use and effectiveness of the approaches and systems developed. The proposal discusses some of the initial findings and developments associated with an extended research study into the development of distance learning technologies that are appropriate, relevant and effective for competence based management education

The paper concludes by suggesting some of the critical issues that need to be addressed in order to provide effective open learning courses.

Towards faculty centered, discipline based courseware

M C Fissel and J M Nyce, Ball State University, USA

Using a book length study of English warfare (1558-1641), this paper will trace a conversion from hard text to a CD-ROM multimedia resource for undergraduate instruction in history. This conversion is intended to support visual models and dynamic representations of history which hard text cannot. It will also address the shift from linear chronology and narrative to higher orders of organization in history (theme, model and interpretation). Because the text and CD-ROM will be issued together, this project will address issues of cross-reference (links) that seldom are taken up in academic courseware development cycles.

This pairing of resources will enable undergraduates to learn about the conventionality of facts, the use to which facts can be put and what this means for scholarly argument and interpretation in general. To put it another way, this development cycle will take into account and rest upon what faculty in history understand history to be and what about it they want to teach undergraduates. To bring this kind of pedagogical emphasis to undergraduate instruction, using hard text and multimedia together and in juxtaposition, can, as an example, have much to say about the directions curricula resources at the university should take in the future.

The second issue this paper will take up is the role that corporate sponsorship (Dynamac, USA) and academic publishers (University College London Press and potentially Yale University Press) can play in a courseware development cycle. The paper will offer some suggestions about the role partnerships between universities, vendors and publishers can have when it comes to curriculum development and curriculum resources. In particular, the paper will discuss both the intellectual and pragmatic (eg marketing) benefits such partnerships can have.

Teaching and learning in cyberspace: towards a model for learner support

Sue Fowell & Phil Levy, University of Sheffield

Teaching and learning in higher education is increasingly taking place within the new educational space created by the electronic medium. This can be seen, for example, in new distance and campus-based courses based on computer-mediated communication (CMC), and in the growing interest in computer-supported collaborative learning (CSCL) and Internet-based programmes. Against this background, a need can be identified for a new configuration of expertise to support the learner in cyberspace. Networked learning demands new skills on the part of the independent learner and new strategies for learner support. Professionals equipped with the knowledge and skills to help learners to navigate and exploit networked information and communication resources are required to work alongside the academic tutor in the new educational space.

We identify the need for a new professional practice which we term *networked resource tutoring* and which is closely associated with the support of learning through computer-mediated communication. This paper examines the background to the emergent practice, and offers a preliminary vision of the activities involved in this practice. These include:

- Support for curriculum development, eg advising academics about the networked resources available to support particular courses and the integration of information discovery and management skills within the syllabus;
- Support for curriculum delivery, eg working as a member of a course team to provide *just-in-time* guidance to learners via discussion lists or bulletin boards set up for the duration of the course;
- Networked delivery of information resource training, eg training on local and global resources including WWW sites, electronic journals, UseNet newsgroups and emergent resources represented by new social spaces or virtual communities in cyberspace;
- Technical advisory work, eg *troubleshooting* with problems accessing resources and publishing on the Internet.

Our vision is further elaborated by presentation of a *day in the life* of the networked resource tutor working on the electronic campus. We argue that the use of the electronic medium represents the basis for a paradigm shift in the way in which academic practice is defined and conducted, and that consideration of a new model for the learner support function and an appropriate means of professional development are both timely and necessary.

A strategy for training communication skills

Shane Gordon and Paul Garrud, University of Nottingham Medical School

In "Tomorrow's Doctors" (1993) General Medical Council recommends that all medical students should acquire *proficiency in communication*. It also urged a radical move to student-directed and resource based learning. In Nottingham, these objectives have been incorporated in a new five year course on Communication Skills, for which we have developed a computer-assisted package, which is integrated with taught classes and clinical experience.

Two requirements of effective skills training in particular are met by this project:

- a safe learning environment, where mistakes will not compromise patients; and
- the opportunity to learn at one's own pace, appropriately for one's own level of achievement, and to revise and practise when needed.

This is a stark contrast to the prior didactic teaching and trial and error apprenticeship which medical students had to use.

The aims and styles of teaching have been revised to develop skills as well as knowledge by adopting new strategies:

- structured analysis of situations is encouraged
- interactive discovery learning is the main instructional tool
- short bullet points voice-overs reduce text on screen
- video illustration is used extensively.

The particular areas covered are based on those identified in the 1993 GMC recommendations, but the emphasis is on the ability to analyse communication situations and to change behaviour accordingly. Each of the seven units addresses a different aspect of Communication Skills used in medical consultations and takes 20-30 minutes to work through. They form a basis for more advanced tutorial work.

Evaluation has been undertaken of:

- *ergonomics*: analysis of how students use the package
- *skills gain*: pre- and post-tests
- *generalized assessment*: appraisal of communication in Objective Structured Clinical Examinations

The real test of success, however, will be whether doctors beginning work after leaving Medical School show significant improvements in their communication with patients,

patient's families and professional colleagues - both in technical competence and self confidence. A plan to assess the medium term outcomes is in development.

Using information technology to change the way students learn mathematics

Harry Gretton and Neil Challis, Sheffield Hallam University

At Sheffield Hallam University the teaching of mathematics to engineering, science and construction students follows an integrated technological approach, using graphic calculators (TI-82 and TI-85), the Excel spreadsheet and the symbolic algebraic package Derive. These products can all interface with Microsoft Word for Windows, enabling students to produce high quality reports of their mathematical activities. A recent development currently being incorporated is the CBL, not computer-based learning but the Calculator-Based Laboratory; this device enables physical data (on movement, light, heart rate, temperature, sound, etc) to be gathered by staff or students in a very flexible and portable way for direct entry into calculators such as the TI-85, enabling mathematics to be instantly related to real world phenomena in everyday settings.

The use of this kind of approach has evoked controversy both within the mathematics teaching community and among those who teach other related subjects.

Examples of questions raised include:

<i>Curriculum:</i>	What changes are possible or desirable in the mathematics curriculum as a result of new technology?
<i>Assessment:</i>	What are appropriate ways to assess students in mathematics and related subjects in a technological approach?
<i>Appropriateness:</i>	For a particular task, what is the optimum technology?
<i>Staff:</i>	How should the use of technology be spread into other <i>development</i> mathematically based subjects, and what are the implications for those subjects?
<i>Learning styles:</i>	Can the use of technology encourage a student to adopt a deep rather than surface approach to learning?

Concerning this last question, in many papers in this area, there is a concentration on questions of curriculum such as: "Here is a nice way of teaching(some topic)....using the TI-85/Excel/Derive". While this is valuable, much of it is based on the notion of mathematics as a collection of techniques waiting to be applied. Such an emphasis can and does lead to the accusation that we are just encouraging *button pressing*. While it is true that technology enables students to solve many problems, it is also true that it provides students and teachers with a means of illustrating concepts and that therefore it is a potent aid to learning.

Embedding new learning technology in higher education: have we learned from past experience?

Peter Hartley, Sheffield Hallam University, and Linda Goodman, Managing Director, LMG Associates

This paper explores how far current attempts to establish new learning technology in higher education have learned from previous studies of IT implementation. We argue that some critical factors are still being neglected, despite powerful evidence from previous studies.

We focus on the EMBED model developed by Goodman from a series of studies in the early 90s: a survey of Further Education Vocational Educational Training focusing on IT implementation; evaluation of the Artificial Intelligence (AI) Applications to Learning Programme funded by the Employment Department; and selected case studies of advanced IT implementation in further and higher education.

The first part of the paper explains the EMBED model, and highlights several key findings:

- that successful IT implementation in education involves 3 key stages - development, introduction, and embedding
- that different factors are critical at each stage

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- that IT-based learning technology will not be properly integrated into the curriculum unless all 3 stages are worked through
- that the final *embedding* stage is frequently overlooked

The second part examines recent developments to see how far the factors in the model are being dealt with. This includes comments on:

- technological development (hardware and software)
- new communication possibilities (eg Internet, WWW)
- recent initiatives in UK Higher Education, notably CTI, TLTP, ALT, etc.
- how these initiatives might further develop, eg recent developments in TLTP such as the recognition for project work as research activity, work of the ELTHE subgroup, and the evaluation study of the programme

Despite all these important innovations, we argue in the final part of the paper that some important factors are still relatively neglected, especially regarding the third and critical embedding stage. For example, are institutions paying sufficient attention to developing the expertise required to maintain/support new software implementation, or the need for long-term planning re staff development? We do believe that new learning technology will have a major impact but the lessons from past experience do not seem to have been fully taken on board: simple introduction is not sufficient - embedding could be the most significant factor in the *world post-TLTP*.

Teaching and learning on the Web - issues for management and assessment

Dr Jeff Haywood, University of Edinburgh

Research in biological sciences is increasingly dependent upon electronic communications and data retrieval. One course aim of the 3rd year Molecular Cell Biology course at Edinburgh University is to develop student research skills, and so email and the World Wide Web have become part of our teaching tools. There are 120 students enrolled on the course and for these projects they work in groups of four. Each group is sent details of its two projects by email and each member of the group return their reports by the same route.

There are unique, although related, projects for each group of students, and submitting reports is mandatory for each student. The two projects are

- a searching the BIDS bibliographic database at Bath for a specific research paper and then answering questions based upon it, and
- b finding a specific protein sequence in the Swissprot database at Geneva (accessed via WWW) and answering questions about it.

The class was divided into thirds (40 students) and each third had one week assigned to each project. Training sessions were provided for each student in the second week of the course, staff looking after groups of 30 on booked PCs. These sessions were based on self-teaching documents produced by the University Computing Services, bound into the course handbook to guarantee availability. Students had access to daily help via email to a course mailbox. Groups could meet in scheduled class time and communicate by email at other times.

Shortly after the project, all students were assessed individually for their understanding of it.

The presentation will examine:

- a the lessons learned from managing Web projects by email in terms of resources needed - hardware, software, staff and student time;
- b issues raised by assessment of the projects with respect to student knowledge and skills;
- c student reactions to these novel modes of learning; and
- d portability of this format to other subjects.

Wore pass-fail in nature. Student-to-staff email was greater than expected, as availability stimulates queries. Post hoc student opinion was complimentary and the projects will be repeated next year. A major advantage is that the electronic projects have allowed us to take 50% more students by providing very cost-effective learning and assessment. This model could be extended to different subjects.

Achieving academic objectives through new technology

Nick Heap and the THD204 Course Team, Open University

THD204: *IT and Society* is a new inter-faculty undergraduate course that addresses the social and technological issues surrounding the pervasion of IT systems into our everyday lives. This course, first presented in 1995, was specifically developed to exploit the potential of new technologies to support a resource-based learning model for distance education. All learning tools and supporting software have been designed for delivery on a Microsoft Windows platform. The three papers for the discussion workshop focus on i) the design and development of the CD-ROMs and supporting tools, ii) the integrative role of computer mediated communication and its user interface, and iii) a summary of the evaluation of the course.

CD-ROM technology provides the delivery medium for over 80% of the study materials of the course, which have been drawn from journals, books, newspapers, government statistics, and commercial publications. In excess of 400 articles have been scanned, edited, and indexed to create a *personal library* for students. Software tools permit rapid retrieval of articles or indexed paragraphs, lexical searches, bookmarks and *cut and paste*. The paper highlights a number of the crucial issues arising during the construction of the CD-ROM, including those of indexing, copyrights, editorial workloads, and the selection of software for the user interface.

Electronic-mail and computer conferencing tools have been provided to all staff and students to facilitate peer-groups, tutor interaction and a group project, the latter to be electronically submitted and graded. Students are also provided with full Internet and World Wide Web browsing tools to gain access to a much broader spectrum of information resources. The second paper will describe the conferencing structures established together with how they have been utilised by staff and students during the course, and report on the role of dedicated *conferencing tutors*. It will also discuss the various software tools provided to students, in particular the off-line message reader.

The final paper will discuss the preliminary results of the extensive evaluation of the course, including postal and electronic questionnaires, weekly log-sheets, and tutor feedback. A member of the part-time tutorial staff will be invited to participate in the presentation of this paper.

The virtual Monash: developing a learner-centred online campus

Lee Hollingworth and Jean Wood, Monash University Gippsland, Australia

Our paper and presentation will overview our work with NetFace, an electronic communications system developed at Monash University Gippsland in Australia primarily for its distance students, but now also used to facilitate interaction between students and teachers located at different campuses of the University.

NetFace facilities include electronic assignment submission, email, conferencing, library services and Internet access. The Netface software integrates these components to present a naturalistic menu-driven environment, conceptualised as a virtual university, with unreal places to go - classes, cafes, forums, the Union, the chapel - and real things to do in those places, such as working in study groups, circulating research proposals for comment, bringing in guest speakers. Whilst students can use NetFace as a gateway to the Internet, and do often go *wandering off*, most of them use it primarily to interact with each other and with their tutors who, by necessity, might also be interacting with each other online.

In 1994 over 700 subjects were offered *at a distance* by Monash University. There are now over 16,000 Monash distance students, scattered not only around Australia, but throughout Pacific Rim countries. Some teaching faculty also work in far flung locations. Through 1994 about 20 lectures and of the order of 1000 remote students had access to online classes using NetFace. The students were enrolled in 30 or so subjects offered across a range of disciplines - in humanities, social sciences, business, education and applied science faculties.

However within these faculties so far only the Gippsland School of Computing and Information Technology can be said to have converted their *deliver* from being mainly print-mediated and for independent study to being mainly computer-mediated and exploiting the opportunities that brings for interactive teaching and *learning at a distance*.

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Our paper and presentation will first highlight milestones in the development of both the NetFace product (Hollingworth) and our understanding of the pedagogical issues associated with it (Wood), and will attempt to penetrate some of the reasons for the slower take-off of computer-mediated interaction in the other disciplines taught *at a distance* at Monash. The presentation will provide background to the hands-on "Workshop for the Geographically-Challenged" we also propose to offer at ALT-C.

A distributed approach to the delivery of online learning resources using the World Wide Web (WWW)

Sarah Holyfield, University of Wales, and Oleg Liber, Educational Technology Consultant

Much of the focus on the potential of the WWW for education has been concerned either with accessing information available over the Internet to support learning, or with the centralised provision of information and learning resources. At UWB one of the strategies being pursued by the institutional TLTP project has been the promotion of the use of distributed WWW servers located in schools and departments to provide a communication channel between lecturers and students, allowing a wide range of online learning materials to be provided by lecturers and accessed by students. This channel will enable new structural possibilities in the teaching/learning relationship to be explored.

Each school or department needs support in developing approaches that suit their particular methods and philosophies, and then disseminating their discoveries, experiences, and strategies. To facilitate this we have established, and are coordinating, a cross faculty and school working group, using computer conferencing to enable cross fertilization and record experiences.

Our approach is based on ideas from management cybernetics concerned with variety management. By providing an alternative communication channel to lectures and tutorials by which learning resources can be provided, lecturers can control the learning of their students through the coordination of their learning experiences instead of by directly providing them. This will create more flexibility for students, and make contact time available for less formal interaction between students and lecturers. Freeing the learning process from constraints of time and place can also enable the whole institution to provide more choice by lifting timetable constraints from modular courses.

It is hoped that the results of this project will allow the institution to provide access to online resources and CAL materials based on an informed strategic approach, and also provide a way of doing this which maintains the autonomy of lecturers whilst supporting collaboration in appropriate areas. It should provide insights into the structural possibilities of using communications technology within an institution, thereby helping it to make decisions on the best way to exploit these technologies in furtherance of its aims and philosophy.

The rule makers v the rule breakers: managing web developments

Ian Huntley, University of Bristol, Mark Pettigrew, Sheffield Hallam University, and Ray Thompson, Sheffield Collegiate Crescent Campus

In many areas of development, it is the creative tension between the Rule Makers and the Rule Breakers which fuels the fire of innovation. Examples abound in everyday life - from grunge music's contribution to popular culture through to the growth of experimental aircraft in the USA encouraged by flexible flight regulations.

The situation is even more marked with developments on the World Wide Web, where the tradition of *communal anarchy* is well established. However, the recent growth in Web usage is highlighting many of the underlying tensions - common standards v experimental development, volume v integrity/reliability, usage for learning v usage for play, corporate needs v individual needs, tidiness v excitement, and so on.

This paper brings together the essential features of existing good practice - pausing to ask what exactly is meant by the term *good practice* - and gives the results of a recent survey of existing Web structures, in term of both design and management. It argues that many of the principles of good practice match closely onto those already in place (and accepted) for other publication media.

The paper concludes by demonstrating examples of many of the principles enunciated, and offers a simple set of guidelines to those wishing to introduce an appropriate element of management into their Web developments.

IT in a small discipline

B S Janday, Aston University

The rapid advances being made in the IT arena require the user to be continually vigilant in every field but especially so in education. The use of interactive video, virtual reality, expert systems, neural nets, multimedia etc can and do enhance teaching in certain areas. However the electronic classroom does have some disadvantages as well. One of the main ones is the time requirement to produce suitable material and the continual need to update both hard and software. A major difficulty for a small clinically based discipline such as optometry is to produce material directly related to the subject. With the explosion of bulletin boards, World Wide Web and the like, a lot of information is easily accessible. In some cases, for example, MRI images of the human body (created for another discipline) can be down loaded and used in lectures without a great deal of modification. Using information

from other sources in general that has to be modified but can still be useful in that it could be more time effective than writing the material from scratch. However, sifting the wheat from the chaff can also be time consuming. So the teacher and learner have access to all this information, but does the availability necessarily make either better informed about their subject? Is the teaching and learning process improved?

The Vision Sciences Department (like most) has tried to reach a compromise between the vast amount of externally available information and some that has to be created internally. Keeping up to date is the name of the game but how far we need to be up to date is questionable. Is a tried and trusted technology better than the over powered or at least over rated IT? The time, money and effort needed to continually play the catch up game needs to be justified in today's climate of the total company trading model employed by the education sector.

The appropriate use of IT in education needs to be assessed. It must be questioned when enough information is enough and when the method of presentation is adequate for the needs of the student, but without burying our heads in the sand.

IT training programmes in higher education: common problems to effective resource utilisation

Gabriel Jezierski, University of Durham

The changing environment in which higher education is operating has resulted in a number of internal and external pressures. Amongst these, the pressure on resources is central and makes it more important to ensure that resources allocated to training programmes in IT skills for staff and students are used effectively in order to ensure the effective deployment of new technologies.

Part of the initial phase of the TLTP 2 Project 45: *Core IT Skills for Teaching and Learning in Higher Education: Tools for the development of a National Framework* has entailed visiting a variety of UK Universities to discover what is actually taking place.

Despite the variety of approaches adopted by institutions to the provision of training in IT skills for staff and students a considerable number of *common themes* have emerged indicating that, in practice, resources are not being used to their best advantage.

These may be grouped as:

- Issues related to the management of change such as where training programmes fit into an overall IT Strategy, Teaching and Learning Policy and Human Resource Strategy.
- Issues related to funding arrangements, commitments and priorities.
- Implementation Strategies and the way institutional attitude and culture can affect the training provision.
- The role of computer services responding to a changing client base and distributed computing environment, issues such as changing roles and documentation.

- How training is to *sit* by academic courses and who should provide it.
- Highlighting these common themes will enable the audience to clarify and address issues which are relevant to their own particular institution.

Cross-curricular IT literacy for university students: developing an effective model

Peter Kemp and Allan Martin, University of Glasgow

There is an increasing demand in higher education institutions, from both students and faculty, for the provision, across the whole range of subject departments, of basic information technology (IT) awarenesses and skills. There are a number of reasons for this, the principal of which are the awareness of both staff and students that IT skills can enhance learning potential, and the perception that IT familiarity and confidence, especially with generic applications, can enhance a student's attractiveness to employers at the end of the course.

At the University of Glasgow the response to this demand has been made centrally, through development of an appropriate IT strategy across the University, and provision of a programme of courses intended to promote familiarity and confidence with IT. A coherent strategy for developing IT use across the whole university is a necessary context for avoiding piecemeal development of courses in particular departments; this has involved the provision of funding and support for IT facilities located within departmental bases, the sponsoring of a campus-wide network and student computing environment, and the funding of a modular course providing generic IT familiarity.

The course programme is being offered during the academic year 1994-95 on a pilot basis. The structure is modular, and is based on a *base course* including those elements considered most essential, and a range of modules which permits students to develop expertise in the direction and to the level they wish, with the focus on either applications or tasks. The courses are offered on a voluntary basis out with students normal timetables. Negotiation is also however under way to integrate the course structure with what is offered at departmental and faculty level, with, in some instances, units of the central course being taught in time and accommodation made available by the department/faculty.

This IT strategy and the centrally-provided IT course are currently at an early stage of development, and evolution of both will be inevitable and desirable. Changes have already occurred, and others are under discussion. Whilst our experience forms only one case, the issues raised will offer valuable comparison with the experience of other institutions.

The World Wide Web: obstacle or opportunity?

Alistair Kilgour and Hamish Taylor, Heriot-Watt University

The excitement and publicity surrounding the spectacular growth in the amount and variety of information available via the Internet, and corresponding exponential growth in its usage, has overshadowed questions of whether all this activity is enriching the learning experience of the majority of users of the network. At a basic level, electronic mail has been of undoubted benefit in enhancing communication between groups of students and between tutors and students in a class, and there are a growing number of studies which show the benefits of email in reducing the effects of status, gender, age and background in group interactions. The benefits of news groups and bulletin boards are less well documented, but there is abundant anecdotal evidence of the advantages to research workers of having rapid and comprehensive access to fellow-workers in the same and related area worldwide, and the use of augmented bulletin board systems for collaborative learning has also been found to be effective in a number of studies.

In this paper the efficacy of the third type of network resource, exemplified and to an increasing extent dominated by the World Wide Web, as an aid and support to learning is examined. As commonly represented, the Internet is anarchic, amorphous and often evanescent - the precise antithesis of what would normally be accepted as a stable and structured learning environment. Anecdotal evidence suggests that after the initial enthusiasm engendered by the novelty and apparently unlimited variety of the resources available through the Web has subsided, users whose primary purpose is to

answer specific questions or uncover specific information required in support of a learning task, soon become frustrated not just by the often unpredictable performance, but also by the quixotic and idiosyncratic nature of what is there, and the uncertainty about what may have been missed. As in the early days of hypertext, the findings of twenty years of research on database systems in computer science seem once again to have been ignored.

The ELF project at Heriot-Watt University, funded by the New Technology Initiative of the Joint Information Systems Committee, has developed a range of tools to provide an improved learning interface to the rich but frustrating domain of the Internet, based on the use of agents which encapsulate knowledge both of the user's current interests and past history, but also of the network sources relevant to these interests, and the peculiarities and idiosyncrasies of the query formats required to extract information from these sources.

A similar interface to that used to dispatch agents, based on extensions to the standard and widely used Netscape Web browser, is provided for the presentation of the query results and the selective retention and structuring by the user of retained material. These tools show promise of allowing a learning-oriented organisational structure to be imposed on the rich chaos of the Internet, resulting in substantial improvements to the productivity and satisfaction of both learners and tutors.

Needs before means: the dialectics of learning and technology

Anny Kling, University of Cambridge, and Andrew Honeybone, University of Hertfordshire

The general argument advanced in this paper is that in the changing context of present day higher education it is particularly vital that our educational purposes and student needs are clarified before decisions are taken about the use of learning technology. That general argument is illustrated through some specific examples of the use of technology in language learning.

The paper will briefly review some of the key controversies about the purposes of higher education that have been generated by the move to mass higher education. It will be argued that even with the increased emphasis on the relevance of courses to future employment and the greatly increased diversity of students, the central purpose of higher education in general and language learning in particular continues to be focused on the development of the individual student's own critical understanding or as Montaigne put it "une tête bien faite et non une tête bien pleine".

The argument will then be developed that whilst the clear definition of the purpose of higher education is necessary, it is not by itself sufficient to ensure successful student learning. For that to occur, any course must also identify the precise and changing needs of individual students at any given time. Therefore, before taking any decisions about which learning technologies to use, the purpose of educational programmes and their relationship to the needs of individual students must be clearly defined.

From these definitions the overall nature of a supportive learning environment can be identified, clarifying the central relationship between students and staff and the role of resources in aiding that dialogue. Only at that point can decisions be sensibly made on appropriate learning technologies as an aid to communication both with ourselves and with others. Such communication is seen as lying at the heart of learning. However, the relationship between general purpose, individual needs and learning technology is not a one way relationship. Once the appropriate use of technology has been initially identified and then put into practice, if successful, the learning technology will itself help to refine further both purpose and needs, leading in turn to further revisions in its use.

The paper will then use this reasoning to develop a critique of various specific examples of the use of technology in language learning. Some early cases of Computer Assisted Language Learning (CALL) will be reviewed and the case developed that the mechanistic presentation of information *per se* is not the central concern. Questions of how to access information and then what to do with it are of prime importance. To quote Montaigne again: "C'est témoignage de crudité et d'indigestion que de regorger la viande comme on l'a avalée. L'estomac n'a pas fait son opération s'il n'a fait changer la façon et la forme à ce qu'on lui avait donné à cuire". Examples drawn from the Erebus Project (multimedia dossier using video, audio and printed authentic material),

the TLTP CKS33 Project (multimedia dossiers for scientists and engineers using video, audio, printed authentic material with integrated CALL packages), and Hypernet (broad band technology system used for distance language learning with the help of multimedia learning tools) will be used to illustrate our arguments.

Understanding learning technologies from the dimension of gender

Gill Kirkup with Anne Jeffs, Open University

Information and communication technologies (ICTs) seem to have the potential when applied to higher education to provide new learning experiences and replace others which no longer seem cost effective. But are they equally effective for all students?

In many universities in the UK and Europe women are now over half of undergraduate entrants, however these women students are still *not* entering the traditionally *male* areas of the curriculum; especially technology and computing. Girls who outperform boys when these subjects are compulsory (up to age 16) do not choose to go on to study them at higher levels. The tradition of women and girls choosing not to study subjects in technology and applied science remains strong despite other changes in the educational participation patterns of women. Could this apparent aversion to technical subjects influence women's attitudes towards ICTs as educational devices, and so have a negative effect on women's overall participation in education?

The paper will review a variety of work on gender differences, and focus on distance higher education; and exploring what gender differences are being identified especially with respect to students' use of ICTs as educational devices. It will discuss different theoretical explanations for the findings and debate how far satisfying the needs of students of either gender is a zero sum game, or whether, despite educational and social constraints, learning technologies can be developed that are equally *friendly* to both genders?

Supporting teaching and learning with learning technology by exploiting directed learning strategies

Rob Lees, Nottingham Trent University

For some time our attention has been focused on the potential of computer based courseware for delivering quality education in a time of increased student numbers and reduced unit costs. In particular, much effort has been put into the production of computer based materials through various initiatives including TLTP.

As a result, small pockets of individuals have been very successful in producing and using materials within their own courses, but the impact in terms of numbers of staff and students involved is minimal. A further unfortunate consequence may be that many more staff are discouraged from using learning technology within their teaching because they see it as the domain of individuals within their department who have gained a vast amount of technical knowledge whilst developing materials.

At The Nottingham Trent university we are currently implementing a strategy whereby inter- and intra- faculty groups of staff are encouraged to adapt and use materials produced externally (either from TLTP or other sources) within their existing teaching. The initiative encourages staff to consider the use of computer based materials (amongst other alternatives) in response to a particular pedagogical need. In this way we hope to encourage a larger number of staff to become involved in using learning technology, rather than form a number of specialist groups of developers.

This strategy has been initiated by the Teaching and Learning Enhancement Centre (TaLEC), which is within the Staff development Service. TaLEC facilitate by forming groups of interested staff into project teams who decide upon which courses and students to target, delivery and assessment strategy etc. TaLEC also help by identifying suitable materials, and by disseminating evidence of good practice from both within and outside the University.

One such project has been initiated within the Faculty of Science and Maths, and involves approximately ten staff from within the Faculty, working closely with staff from Library and Information Service and Computing Services facilitated by TaLEC. Over the first 6 months of this project we have identified various pitfalls and unexpected successes associated with adopting this institutional strategy. In this workshop I will outline the progress of this particular project to date.

The effect of changes in technology on pedagogic approach - a case study with MRP (Materials Requirements Planning)

Laurence Legg, University of Central Lancashire

The aim of this paper is to detail how a desired pedagogic approach and the available technology have interacted in the development of the teaching of the topic of Materials Requirements Planning (MRP) within the subject area of Production Planning and Control, at the University of Central Lancashire. The viewpoint is from a non-specialist in IT or programming, and who has no control over the University's IT strategy.

The paper will detail the different teaching approaches used and investigated over the last 10 years, bearing in mind that MRP is part of a computerised manufacturing system, highlighting the constraints, problems and lessons learnt due to hardware and software limitations existing at the time.

The paper will discuss current and planned developments in the use of available hardware/software. This, we believe, will lead to a more rapid and easier progress than previously to our desired pedagogic approach of allowing the students in a controlled simulation environment to make decisions and understand the consequences of these decisions.

A tool for creating interactive simulations in physics education

Yibing Li, Isabelle Borne, Ecole des Mines de Nantes, France, and Tim O'Shea, Open University

Learning physics, particularly mechanics is an area with which students often have difficulties. It has been widely acknowledged that computer-based simulation can make significant contribution in helping students overcome their learning difficulties in this area. Simulation allows learners to control complex systems, manipulate variables, run experiments, take measurements, etc, in ways which would be difficult or impossible to achieve with real world systems. However, many simulation systems only allow users to use pre-designed simulations. If teachers want to create new simulations in solving the particular problems which their students have, they have to be able to program in the underlying computer language. This adds unnecessary burdens to the teachers and reduces the usefulness of the simulation systems.

In this paper, we describe a simulation creation software named Scenario Design Tool (or SDT) for teachers to create interactive simulations used in the learning and teaching of mechanics. SDT is built on top of an earlier simulation system called DM. In SDT, teachers build a simulation microworld by modifying scenarios already existing in the system or they can create new scenarios from scratch. SDT provides a direct-manipulation interface with which users can create a scenario by selecting required simulation components provided by the system. The users then interactively define the properties of each chosen component and relationships among the components. The components provided by SDT include: measuring devices (eg digit and analogue meter, graph, video recorder, ticker tape); control devices (slider and button); moving objects and motion objects which govern the motion of the moving objects. Users can create a scenario in SDT without programming. The system also animates the motion of objects so that students can visualise the consequences of their reasoning.

The design of SDT is based on the object-oriented paradigm which is ideally suited for developing educational software systems such as SDT. In the end of the paper, we will briefly discuss the advantages the object-oriented paradigm offers.

Tips, tricks and traps for multimedia developers

Howard Lincoln, National Council for Educational Technology

In response to a request from NCET's Universities Forum, a series of case studies examining models for the authoring of multimedia courseware in the University sector were carried out during Spring 1995. The studies will form the basis of a publication available in autumn 1995.

The case studies describe a number of initiatives concerned with the authoring of courseware. Examples range from large externally funded TLTP consortia, through initiatives funded by individual institutions, to individual academics working without any significant internal or external support.

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This paper will draw on the experience of those institutions covered by the case studies to identify some of the issues which concern courseware developers. In this respect the presentation will contrast the experiences of the developers included in the study and extract some general pointers to guide any institution, department or individual planning a similar initiative.

Aspects covered by the studies include the composition and management of development teams, staffing issues, the requirement for, and nature of, institutional support, the development process and review and evaluation.

Establishing a support service for educational technology within a university

J A Longstaff, Kim Whittlestone, John Edwards, Jane Williams and Patricia Hammond, University of Bristol

Introduction

1990 the University of Bristol established an Educational Technology Service (ETS) to encourage the greater use of learning technology with the University. Its mission statement is *The ETS exists to support and promote (for the benefit of the University of Bristol) the appropriate use of technology in teaching and learning.* Now recognised as a useful part of the University infrastructure, to reach this point the team needed to be extremely aware of the aims, objectives, knowledge and strategies necessary to achieve the Mission Statement. This paper is a reflection of a range of strategies that we feel may be transferable to other institutions proposing to institute similar support strategies for learning technology with their own institutions.

ETS activities

To effect the Mission Statement the ETS has divided its activities into three categories. These are *service activities*, (promotion, information, training and advisory,) *focused activities*, (productivity tools - eg templates and in depth support for specific learning projects) and *academic activities*, (research and development, collaboration, networking publication etc) Each of these groups has a clear purpose and the Unit complements these with a range of management activities which enables continuous re-evaluation and evolution in response to need.

Strategies

In the course of the last few years, the team has developed *academic strategies*, (production teams, needs analysis etc) *technological strategies* (don't let the material be technology-led, coping with moving goal posts) *political strategies* and *management strategies*, (location within University structure, policy development and planning, quality assurance and value for money) which appear to work well on a relatively tight budget.

The paper will detail some of the more effective strategies as well as outlining our view of the obstacles yet to come. Our approach has been consistently pragmatic. Academics have been often misled by the atmosphere of enthusiasm and hype which surrounds learning technology. We are, however, seeing a steady growth in the use of learning technology in a principally research-oriented University and feel that our approach is both sensible and effective.

Engaging the learner - changing the system: the impact of problem based learning (PBL)

Ray McAleese, Heriot-Watt University

Although problem based learning (PBL) has been an effective pedagogy for at least twenty five years, its impact on the higher education system in the UK has been low. Since the early applications of PBL in Medicine (Barrows, there have been significant examples in other professional disciplines especially Business Studies and the MBA.) In Heriot-Watt the move to a flexible curriculum has encouraged teachers to experiment with computers, yet there is resistance to change that involves *deep* curricular changes. In developing study skills modules the author has been able to adopt PBL as the pedagogy that underpins a module on Problem Based Learning (301PS3). The module was first delivered in the Summer term in 1995. Some 40 students took the module. In line with the approach in other study skills modules, the process was

evaluated using a range of instruments - including confidence measures, assignment marks and reflection records.

This paper describes the underlying nature of PBL (situated learning and authentic tasks) and distinguishes it from Case Studies) and Goal Based Scenarios. The PBL philosophy is placed firmly in a category of supportive learning environments. The content of the course is described showing how the PBL approach effected the assessment, the teaching and the use of resources. A model of the PBL approach adopted is described and the implications for teaching are drawn. The PBL model that emerged in Heriot-Watt uses a mixture of key lectures along with problem solving groups - both tutor-led and student-led. The role of the teacher becomes the *animateur* and the learners adopt a significant responsibility for their own learning through a process called auto-monitoring.

The conclusion of the paper points to the distinction between *surface* change (eg adoption of different media) and *deep* change (curricular changes that effect assessment and the process of learning). It is suggested that there is a pay-off between innovative approaches to teaching and learning that provide high status but low impact on learning (eg CBL) and innovative approaches that necessitate low status and high impact on learning (eg PBL).

Software quality courseware on the WWW

Moir McAllister, University of Sunderland

This paper outlines the design and development of hypermedia courseware for the subject of Software Quality which is presented using the World Wide Web. The subject is taught at final year undergraduate degree level at the University of Sunderland, UK.

The World Wide Web has enormous potential as a platform for the development of courseware. The concept of producing a course using hypermedia which can then be made available on a global scale is gaining support, particularly given the increase in student numbers and the use of open learning and distance based learning by universities in the UK.

This paper describes the construction of the system with respect to the platform used, the interface design, the complexity of the material and the modes of interaction with users and other software systems such as email. The evaluation criteria and test results are then presented and recommendations are made with respect to extension of the system. Finally, conclusions are drawn as to the worth and value of such systems.

The impact of some critical institutional and strategic issues on the implementation of a university wide teaching and learning policy

Audrey McCartan, University of Durham

The Teaching and Learning Technology Programme Project No 45, *Core IT Skills for Teaching and Learning in Higher Education: Tools for the Development of a National Framework*, has gathered information from the 11 consortium universities in order to develop a framework for the identification and delivery of IT skills for teaching and learning through a survey of the IT training needs of academic staff and their students in the teaching and learning context. The involvement of the project over a period of two years with each participating institution has demonstrated the significant impact of change, as a function of a number of external and internal pressures such as teaching quality assessment and the diminishing unit of resource, to be a situation common to all the institutions. This has highlighted the need for staff development and an effective IT training programme, supported by a firm commitment at the institutional level and a clear relationship with an institutional IT strategy and staff development and training policies, as well as appropriate resource allocation mechanisms.

Based on the information collected, a number of case studies will be presented of representative (though fictitious) universities to raise some critical institutional and strategic issues such as different ways in which IT may be used and how these would affect and change the job functions of all personnel with particular reference to the delivery and assessment of teaching and learning. The impact of these issues on the formulation of strategy to implement a teaching and learning policy, senior managerial roles and the provision of training for staff in a variety of job functions will be consid-

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ered. Developmental models of IT skills programmes will be described. These illustrate the characteristics of institutional provision ranging from centrally organised, usually provided free and open to all but not strongly integrated into the curriculum, to a market economy model where payment for services and locally organised training would be the norm. The variety and significance of resource allocation mechanisms on the implementation of university practice will be emphasised, particularly the implications of devolved funding arrangements on institutional practice.

They're changing screens at Buckingham Palace

John Mason, Open University

The power to form mental images is crucial to human beings. The mind tends to work on what is possible rather than on what is, witness the work required to train artists and scientists to attend to what is seen and not what they imagine they see. Imagery can be supported by the use of external screens. I suggest that the transition from printed paper as screen to electronic screen, is a fundamental revolution in the very nature of knowledge, epistemology, and philosophy of education, and the use of mental powers.

When Johann Gutenberg began printing multiple copies, there was great concern that human powers of memory would atrophy. To a large extent, these predictions have proved correct. It is easy to spin stories that we now use metamemory, to remember where to find things rather than the things themselves, but undoubtedly memory powers *aren't what they used to be*.

Printing made paper into a viable support screen, so that mental images could play on imagined variations and extensions. Printing also provides access into imagined worlds triggered by the words of the novelist, poet, and scientist, and the static drawings of the illustrator.

We are now experiencing an even greater revolution than Gutenberg's, in the move to electronic screens. Screen images are supplanting mental images in just the same way that print supplanted memory. Only it is harder to resist. Our mental space is being swamped, even polluted, by ever more complex images and image sequences, removing the need to exercise mental powers. Yet the most enduring images are the ones that make sense, that can be re-constructed and re-entered by the individual.

"An educator's life is terribly hard", said Alice. Dynamic, directly manipulable screen objects make it more important, not less, that we attend carefully to the psychology and sociology of sense-making. It is more crucial than ever that students be encouraged, even trained, to work-on ideas not just work-through stimuli, to distinguish between an account-of a phenomenon and accounting-for it in affective-laden language, to be able to recount accounts-of phenomena and to tell stories that account-for them.

Electronic screens may give us access to a further meta-shift in mental, powers just as printing did to memory, but there will be a considerable shake-down period as we find out what this really means, and then try to ensure that everyone has access. I hope we will be more successful than we are with reading!

A strategy for investing in evaluation: a case study

J D Milne and S B Heath, Aberdeen University

Evaluation is vital to the production of courseware that students can use and learn by using. Yet when properly implemented, evaluation can become a significant cost item in the development process. Although there are a number of good guides which outline the methods that can be used and how to apply them, they do not highlight the relative costs or the likely benefits of each method. It is essential to assign evaluation resources efficiently. Costs can be minimised by identifying the issues critical to the development of effective courseware. This paper will address these issues using the evaluation strategy developed by CLUES as a case study. The objective is to provide guidelines for cost effective evaluation.

The CLUES evaluation strategy has identified key issues in evaluating courseware. Methods to assess these issues have been considered and a balance has been reached that collects both in-depth data and information that is easier and cheaper to collect and analyse. The methods that have been adopted include:

- Student interviews
- Student observations
- Student pre-test post-tests of learning gain
- Student pre-test post-test of attitude
- Student questionnaires
- Expert walk throughs
- Lecturer questionnaires

This evaluation strategy provides answers to specific questions yet is flexible enough to also capture the unexpected.

The costs for each evaluation method are discussed in terms of the likely benefits. Many of the benefits are difficult to quantify in financial terms, for example, how do you cost the gains in credibility as a result of producing more effective courseware. What are the benefits of subjecting the lecturers and students to fewer problems than there would otherwise be? These issues will be addressed in the guidelines for cost effective evaluation.

Expectations and realities of collaborative development: lessons learned

M Milner, R Madigan and S Tickner, University of Glasgow

The University of Glasgow's TILT Project is composed of six groups. Groups A to D are engaged in creating or adapting computer-based material, while group E provides a specialised evaluation function.

Group A is the Numerical data group of the TILT project, with the aim of enabling students to work independently acquiring skills in handling Numerical data. To this end we have developed GraphIT - a self access ToolBook package about data analysis and graphical representation.

A distinctive feature of the group is that we work across departments. The team is composed of two developers and six academic staff from the Departments of Statistics, Accounting and Finance, and the Social Sciences.

Here we consider a variety of organisational and conceptual issues which the interdisciplinary team faced, from the inception of the project in the context of an institutional bid, to the difficulties of day-today scheduling and assigning tasks.

As we approach the end of the three-year project we draw some conclusions and offer recommendations for collaborative projects, including the roles required in the team, some insights into project-versus-institutional structures and the importance of clarification.

I've heard it on the grapevine...

Marina Mozzon-McPherson, University of Hull

This paper analyses the results of a project involving a group of 30 students in the teaching and learning of Italian using electronic mail and the World Wide Web. The session will describe how the experiment was conducted, its implication for language learners and the learning process and give a first evaluation of the outcomes.

The paper will also compare this learning experience through email - still more widely available in higher institutions- with a pilot experiment using the conferencing system FirstClass. The comparative study will include the use and application of these two different forms of technology in terms of skills required by the learner and the tutor, the inter cultural implications, the language learning process etc.

The project, which started on campus as an open learning support for students who were following a language course in Italian, has now incorporated a group of students who are not part of any course and have joined in from the USA, Germany, Canada and Ireland and actively contribute to the language circle.

The project tries to embrace three main language issues: inter cultural communication through topical discussions, language learning through tasks, activities and games, autonomous learning training using technology to support searching skills, language learning skills.

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The author is currently analysing these three aspects and will attempt to explore the new language which has developed as a result of the media chosen, the implications- both linguistic and psychological- which the use of electronic mail and CMC may have on language learning and the potential for future development in teaching and learning languages at a distance.

Mathematics in undergraduate science: is there an alternative to show and tell?

Dr Richard Noss, University of London

There is widespread concern regarding students' understanding of mathematics in numerate disciplines such as science and engineering. The option to address the problem by increasing lectures, seminars and tutorials is increasingly unattractive. In part, this is for reasons of pragmatism - financial constraints, increase in student-teacher ratios etc. But there are other, more fundamental objections: it turns out that the mathematics required by such students is only elementary from the point of view of the mathematician. Understanding the fundamental structural ideas of mathematics and their application - developing a mathematical way of thinking - is at least as important as acquiring skills. For this kind of deep learning, it seems likely that students will have to do more than act as passive recipients of mathematical facts and techniques.

A project is currently underway to address this problem via a computer-based system which exploits *Mathematica* - a powerful Computer Algebra System. The intention of the design team¹ is to offer science students the opportunity to learn about and explore a range of mathematical topics which will be useful in their science and engineering courses. The idea is to use *Mathematica* in more than the *standard* ways (eg the production of attractive graphics, the parsing of student answers); the stated aim is to provide *the opportunity for students to explore and do creative mathematics for themselves*. This paper will explore the extent to which this aim has been realised.

I will focus on how students viewed the system, and in particular, the feasibility of using *Mathematica* as an exploratory tool in this context. The paper will present findings based on extensive data collection which includes: observations of students using the materials; post-session interviews with students; computer-recording of student interactions; a sample of pre- and post-test data; post-test data from all students; and interviews with teaching staff.

¹ The design team are based at Imperial College London. The research here forms part of the evaluation of the evaluation of The Transitional Mathematics Project No 15 of the teaching and learning with technology programme, funded by HEFCE.

Let's get away from user guides - an appropriate approach to IT literacy

Mark Pettigrew, Sheffield Hallam University

Why is it that when we teach information technology to non-computing students we apply so badly all that we hold dear about effective teaching? Comparing teaching and learning resources for IT literacy indicates that the main strategy for developing students' IT literacy involves *talking* them through a sequence of actions and then expecting them to learn by simply copying the actions. Watching students use these resources indicates that they only succeed by a process of *error recovery* - they frequently get lost as listed sequences of actions do not work as intended, and they survive by developing routes back to the intended path.

No attention is given in these conventional mainstream resources to the development of cognitive frameworks, or to helping students identify and develop those skills and strategies which will help them though the tangle of new operating systems, major revisions to software packages, and the outgrowth of new paradigms in IT in the years to come. Little attention is given to helping students become aware of the process of learning and using IT rather than learning a mechanical skill by rote. Any development of self-awareness is achieved only where students come to terms with the inadequacy of the learning materials.

This paper illustrates a new approach to IT skills development, getting away from *button-pushing* to take account of how students learn and what learning outcomes we need to produce independent learners in this area.

Never mind the quality - is it being used?

Mark Pettigrew, Sheffield Hallam University

In the world of Human-Computer Interaction (HCI) design, usability and use are often assumed to be equivalent in that a well-designed technology-based learning resource is expected to be widely used. However, a large number of such resources in universities are being developed part-time by subject tutors. These tutors typically have little experience or knowledge of software usability and recent research in this area. They do not have time to learn in detail about HCI or to carry out extensive usability testing during the development of learning resources. Many of their products would be considered poorly-designed by usability tests, but are nonetheless used widely and effectively as student learning resources.

For technology-based learning resources to be widely available, there has to be a significant niche for the equivalent of photocopied lecture notes - a computer-based resource which is capable of being put together rapidly by a subject tutor or subject team without extensive knowledge of the medium and for minimum cost. This would also be expected to have an associated benefit of minimal cost for future amendments. Even though there is something to be said for a judicious amount of staff training in general HCI principles, rigorous approaches to usability and HCI are unlikely to be of much use to these developers.

This paper considers which common points of *good practice* in HCI design could form the basis for a core methodology amongst overworked university teachers. It looks at a number of learning resources developed in universities to examine which so-called tenets of HCI practice are being ignored and how important this really is for the target audience. Finally, it discusses which elements of good practice really belong in the hands of subject tutors and which should be left to skilled software developers providing tutors and developers with a limited number of well-developed interface designs into which to place their subject content.

Importing maths learning packages - a case study of a large scale rapid change of resources and organisation

M J Pollock, E McAteer, I Turner and G F Doughty, University of Glasgow

This paper presents a case study of a large-scale rapid change of resources and organisation. The University of Glasgow's institutional TLTP project, *Teaching with Independent Learning Technologies* (TILT) has been assisting and studying ways of overcoming Not-invented-here resistance so that externally produced packages can be imported with little pain.

A lecture-based maths course for engineering students had shown typical problems, with poor learning in a mixed-ability class of 200. Two of the authors were responsible for a particular group of students in this class. With confidence based on experience within the TILT project of introducing learning software by employing a rigorous set of formative evaluation tools. Two maths packages were purchased only one month before the start of the term and used to deliver all of a maths course designed to bring students from a wide background to equality by the end of their second year. Learning has been through CAL tutorials with each student following an individual programme of work.

This paper reports on the experience from the teachers' and students' perspectives. This was studied with questionnaires and focus groups, confidence logs and diaries, and diagnostic and summative assessment, including comparisons with previous years. Some predicted problems occurred, others didn't, and there were unpredicted problems as well. We report on changing resources, timetabling, tutor and peer support, and the students' reactions to the ever-increasing amount of time spent at the terminal.

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Resource-based learning strategies: implications for students and institutions

Malcolm Ryan, Julian Wells, Alan Freeman, and George Hallam, University of Greenwich

In its strategic plan the University of Greenwich envisages a significant shift to resource-based learning (RBL). Enterprise in Higher Education is supporting 5 pilot projects in this field. An introductory economics course provided by the School of Social Sciences to other faculties is one of these.

This project has adopted a sound curriculum approach by reviewing and re-writing existing learning outcomes. It has established a project team including both subject specialists and educationalists, who have produced a students guide to existing and new resources.

Innovations include:

- abolishing lectures in favour of a diverse range of teaching and learning strategies
- using computer-based methods both for assessment of students and for student evaluation of the course
- using team teaching
- adopting an open approach to assessment
- using student feedback to modify practices

This paper will present the findings of a mid-semester student evaluation of the unit; raising a number of issues which RBL poses in relation both to students needs and the University's resource provision. Indications are that while the innovatory aspects of the course are strongly welcomed (79 per cent supported the computer-based activities) they also show strong attachment to some traditional methods. No less than 94 per cent of those who suggested changes to the range of activities asked for reinstatement of at least some lectures, generally as additions to existing activities.

Detailed exploration of student reaction to the innovatory elements suggests that lectures are valued for the opportunity they provide for closer support from the most traditional learning resource of all teachers. Seminars although welcomed by two-thirds of students were clearly less popular than other activities, with a strong demand for more structured, tutor-led activity within them.

Our initial finding is that institutions which believe in RBL must convince students of its efficacy: their reactions to the present project may be explained by its novelty.

Generalising these innovations requires not merely instruction in new learning skills but a change in the culture of teaching and learning. This requires both adequate and appropriate resources and further investigation of the demands of new learning technologies on the learner.

Matching educational technology to learning goals

John Sparkes, Open University

It is important, especially when introducing technology into education, to match the teaching methods used to the intended learning goals. (Here teaching is regarded as the creation of educational environments which help students achieve their learning goals). But such matching is rarely undertaken explicitly, even in face-to-face teaching, hence the need for change.

Various educational taxonomies for distinguishing between different learning outcomes, have been proposed since Bloom's famous pioneering work, but outcomes do not map unambiguously on to different kinds of learning. For example, once the required outcome of *understanding* has been specified (eg as in the SOLO taxonomy) it is usually possible to achieve it without having understood very much. A helpful taxonomy of *learning* contains the following elements, provided they are carefully defined, as in the paper. The terms are normally used very loosely.

Knowledge, can be taught by providing information, or making it available, in a motivating way. Here Internet and multimedia, for example, can play a key role.

Skills, are taught by instruction and demonstration followed by error-correction. They are learnt through practice. CBT and simulators can be excellent for developing measurable skills, but more complex skills usually require human interaction, such as that provided, where appropriate, by computer conferencing.

Understanding is difficult to teach using technology because it involves providing opportunities for students to express their understanding or to problem-solve in their own way. Assessing these outcomes appropriately requires expert judgment.

Know-how can be augmented through simulators, but it is doubtful whether these can on their own, develop the know-how that *real* experience develops.

As regards the *affective domain*, educational technology *motivates* some learners but demotivates others. Well used, however, (eg in TV) it can have a strong effect on *attitudes* and *values*.

Hence, if educational aims are expressed in terms of the different kinds of learning expected of students, it is possible to match educational technologies to them.

The question of new technology push or pull in the university classroom

Melissa M Spirek and Anthony Short, Bowling Green State University, USA

Past research has demonstrated that the adoption of new technologies is influenced by a number of factors. Rogers' theory of the diffusion of innovations (1983) offers one framework for understanding why one technology is adopted by one group and yet the exact same technology is rejected by a similar second group. Diffusion of innovations predicts that four areas are directly related to the adoption of new technologies: relative advantage, compatibility, trialability and observability. This perspective also predicts that one factor is inversely related to adoption: complexity. The objective of this paper is to compare and contrast two groups (those who do and those who do not use new technologies) of university professors in order to determine if these five factors are related to a professor's likelihood of utilizing new technologies in the classroom.

The support of a university's faculty can greatly influence the efficiency of implementation and the likelihood of a successful integration of new technologies in the classroom. It is time to move beyond age, sex, monetary cost and saliency to one's academic discipline (eg telecommunications or electrical engineering) as predictors of the likelihood of professors' adoption of technological teaching innovations. A survey of a sample of faculty at a university that offers a wide range of technological teaching innovations will be presented. In addition to these four traditional independent variables, the authors of this paper will examine Rogers' five influencing factors.

New technologies will be defined at both a macro and micro level. At the macro level support for a distance learning program will be explored and at a micro level technologies for teaching such as computers, Internet and the World Wide Web will be examined. The relationship between the use of new technologies will also be examined. For example, is a faculty member who is currently teaching as a distance learning teacher also the one likely to include computer graphics as a means to highlight the main points of his or her lecture? The findings of this paper should provide evidence for institutional or departmental strategies that encourages greater use of new technology in the classroom.

Results of a survey of the use of computer assisted assessment in higher education in the UK

Derek Stephens, Loughborough University

As student numbers in HE increase without a proportional increase in staff the impetus to utilise information technology to assess students appears to have become more and more prevalent. The need to test students to determine their existing knowledge, both prior to and during modules, has become more necessary as the student intake have become less uniform as the variety of qualifications considered appropriate for entry to university has increased. Further, the development of more sophisticated assessment question types such as *hot spots* has focused attention on CAA (Computer Assisted Assessment), with the use of PCs and OMRs as delivery systems for formative and summative assessment.

These are available out of contact time, have infinite patience, absolute accuracy and can help to alleviate staff marking time. In some cases, however, individual staff are attempting to put CAA in place with only minimal support or prior training. There

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appeared to be a need to research the current level of development and use of CAA, and publish the results as a guide to activity to disseminate good practice and help avoid unnecessary problems. Consequently a questionnaire survey has been conducted to identify HE users in the UK. To date over 300 responses have been received from a wide variety of users and institutions. The results in the paper will include analysis of the following:

CAA hardware and software in use

- names of OMR systems and CAA software being used
- prevalence of Optical Mark Readers (OMRs) vs Computer Based Testing (CBT)

Test development levels

- level of test subjects
- numbers of students being tested
- subject area of tests and the relevant CTI centre affiliation
- test type (diagnostic, formative or summative)
- length of time of test and numbers of questions asked
- how long the test has been in use
- types of questions (MCQ, Text Input, Hot spot)

Evaluative comments on using CAA

- advantages and disadvantages
- specific problems encountered
- are users likely to increase their use of CAA in the future?

A new grammar of multimedia

Matthew Stratford, Open University

The grammar of a language binds the elements of that language together in a commonly agreed form so that people are able to use it to communicate. For spoken language it is the rules about inflections, relationships between words and its phonetic system that make it possible for us to understand one another.

This paper presentation will use the grammar of film as a starting point to thinking about the grammar of multimedia. Film and video share some similar qualities with multimedia: they are rich media that bring together other simpler media elements (sound and image), their grammars are less formal than those of spoken and written languages, and they are more easily read than *spoken*. While it is useful to use the grammars of film and television as a tool it must be remembered that multimedia is a new and unique medium.

It is a new medium because of the combination of media and the use of computing power. Multimedia brings together elements of traditional media but use of these elements is different. The grammars of these media not only change when used in multimedia but there is also a new grammar built around the integration of them too.

The computer in multimedia makes it an active medium, something that is completely new. It enables multimedia to be interactive and adaptive, building a discourse between learner and system, and through the system the educator themselves.

To make effective multimedia, educators will first need to identify the students learning needs and then know how to meet these needs by a proper understanding of the potential and use of multimedia. The paper presentation will argue that considering a grammar of multimedia helps to do this by providing a new way of approaching such intangibles as narrative, learner control and structure. The paper attempts to outline some of the rudiments of a grammar for multimedia, and to look towards how it might develop.

Computer algebra systems and mathematical teaching/learning in higher education

Shyashlow Sun and Sin-Min Tsai, National Taiwan Institute of Technology

Computer algebra systems (CAS's) are wonderful! Hundreds of ideas about what we can do by using a computer algebra system have been proposed by mathematicians. However, before we rush into the stream of CAS's and change our teaching styles, let

us ask this question: Are CAS's suitable for mathematics classes? How do we use it in teaching / learning mathematics?

The authors are experienced in using CAS's in calculus classes. We suggest that using CAS's can improve mathematics teaching/learning in the following aspects:

- Save time in mastering skills.
- Widen students scope of vision.
- Better understanding of functions and theories.
- CAS's are good tools in doing investigations.

However, using CAS's in mathematics classes can be risky. Mindless adopting CAS's may mislead students into a different territory. We suggest that CAS's can never be used in the following manner:

- Show the result and say how powerful CAS's are.
- Rely on CAS's too much.
- Give students a CAS and let them do free investigation.

Examples of these kinds of usage and their influence on mathematics learning will be discussed in full paper.

Mathematics may be roughly divided into concrete knowledge and abstract logic. The concrete part includes results, facts, rules, formulas, etc. These constitute the major part of course contents. The abstract part includes mathematical concepts, logical inferences, inductions, deductions, the ability to read and use mathematical language and symbols, etc. They inhabit everywhere in mathematics but are usually hidden behind concrete knowledge.

CAS's can show concrete knowledge easily and accurately, but they cannot demonstrate the flow of mathematical thinking. It is teachers' responsibility to make good use of these tools and develop a lively mathematics lesson. In the future, we may leave routine works to CAS's and pay more attention to logical thinking. Furthermore, because CAS's have nice computing and graphing ability, complicated problems can be studied intensively and extensively. Students' creativity and general mathematical ability will be enhanced.

Valuable innovations: issues in implementation and evaluation

Alyson Tonge, University of Teesside and Denise Gallagher, University of Huddersfield

The impact of Information Technology on programmes in Higher Education is well documented. However there are no recorded scientific tests which isolate the role of technology in providing better teaching quality. Accounting education has provided one of the major thrusts to the innovations with work on skills, learner support and most recently Computer Based Learning (CBL). The HEFCE Teaching and Learning Technology Programme (TLTP) recognises the importance of mechanising learning in particular circumstances and has funded a range of projects across a broad spectrum of Higher Education disciplines. One such project is the Accounting Consortium, TLTP BYZANTIUM, whose objective is to develop interactive software to deliver the curriculum typically found in first year accounting courses.

The challenge of educational proof will not be answered as it is not within the scope of the paper to address these but rather to consider the strategy for providing a base from which persuasive evidence can be derived. We therefore report on progress made in developing a strategy for the evaluation of the learning in a range of undergraduate accounting classes using BYZANTIUM products and record the progress made in using CBL in the classroom.

It is increasing clear that a major change in learning method such as that created by the use of CBL has an important and as yet unquantified cost in terms of the required resource base and the impact on learning and teaching styles.

We wish to raise these issues in discussion with colleagues at the Conference to continue the debate on evaluation methodology and resourcing implications.

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Dictation or direction?

John Townsend and Andrew Sackville, Edge Hill College of Higher Education

In strategic terms, Edge Hill College has taken two main approaches towards promoting the greater use of learning technology.

- 1 While it may be true that you can take a horse to water but you can't make it drink, the issue becomes academic if there is no water there in the first place. We have therefore introduced the technology and structures necessary to enable the use of IT in Teaching and Learning in parallel with, and even in advance of, any user requirement. This first phase of development took place in the eighteen months up to December 1994, and included the introduction of ASSIST (Access for Staff and Students to Information Services and Technology,) an umbrella organisation coordinating the work of all Learning Services. We also embarked on a massive increase in the scale and sophistication of networked facilities, moving from c. 400 to over 900 PCs available for staff and students, together with a range of new software and multimedia facilities. The second phase is a central programme of events and training courses to promote the use of IT in Teaching and Learning across the College, on the basis of what people can actually do NOW.
- 2 We are also trying to get all the horses drinking rather than just the few that are particularly thirsty. We have therefore endeavoured to ensure that all staff and students have access to all but the most specialised facilities, and have concentrated on central provision of desktop machines for students, and on making a PC available for every office based member of staff. The aim is to make the use of IT an integral part of the working life of all participants in the College experience. To this end we introduced an IT Entitlement for students envisaging a grounding in the basics of IT for all students regardless of discipline. We are now moving from training for specific tasks to training for awareness and empowerment for staff and students.

Ariadne: supporting the learning of system-independent information searching skills

Michael B Twidale, David M Nichols, John A Mariani, Tom Rodden and Peter Sawyer, Lancaster University

Students in Higher Education are increasingly making use of online information resources. The databases are growing in both size and number, and their interfaces not only vary from system to system, but individual systems themselves evolve. Consequently, in both academic and commercial environments, there is a growing recognition of the importance of learning generic information searching skills.

Unfortunately many students acquire only a rudimentary competence in these skills. Attempts at formally teaching information skills have often been problematic. By contrast, students prefer to learn by attempting searches required for their own studies, by experimenting and from other users. This can be a very productive means of learning, but current systems provide little support for learning generic skills.

One cause of this lack of support is that current online databases emphasise product (the hits) over process (how to obtain the hits). Supporting the information search process implies: recording the entire search interaction, allowing a visualisation of the search, preserving information across sessions and allowing the search process itself to become a manipulable object.

Some of these facilities are partially provided by certain systems but typically an online database such as BIDS only records the search hits. Consequently, the record of good and bad search techniques can appear identical. Other systems, including most library OPACs, do not record the search process at all.

Our system, Ariadne, records users' interactions with an online database and preserves all of the available information about the search process. The resulting visualisation of the search history can then be used as an external memory, an aid to reflection and as a general educational tool. For example, searches can be edited, annotated and shared amongst users (in order to support collaborative learning) and librarians. We have tested the system on students from Computing, Chemistry, Psychology and Women's Studies, and report on our findings. The visualisation of the search process is both comprehensible to novices and can serve as a focus for discussion of classic searching errors such as reading through an excessive number of hits.

A multimedia-based case scenario for teaching business computing skills

R D Ward and J M Ward, University of Huddersfield

The case approach to teaching, delivered by means of printed materials and live role-play, has been used successfully in teaching systems analysis and other subjects for many years. The approach typically requires students to conduct a systems investigation by reading printed documentation and by interviewing personnel from an imaginary organisation played in role by members of the teaching staff. These exercises can be a source of rich learning experiences.

One major problem with the approach is that it can take up prohibitive amounts of staff time. For example, a scenario consisting of 10 roles to be investigated by 100 students working in groups of 4 would require 250 interview slots of 20 minutes each. Staff taking part would need to spend time learning their roles, interviews would need to be scheduled and someone would need to make sure that all role players had supplies of the documents and data required by their role. A total of 150 person-hours would not be unusual.

The demands now being placed upon higher education are making it impossible to continue using the case approach in this traditional form. We have therefore been investigating the potential of computer-based case scenarios in teaching business computing skills. A scenario based upon an imaginary equipment maintenance business, where engineers visit customers' sites to repair and maintain items of equipment, has been created and marked up in HTML for delivery by Mosaic or other web viewers. The scenario includes organisation charts, job descriptions, business procedures, documents with and without data, marketing materials, internal reports and floor plans.

The scenario forms a resource which can be used to support a variety of learning activities. Initially we have used the scenario in two activities, systems investigation and database design. The paper will describe the scenario and present some observations from these initial teaching experiences.

Collisions, communication and collaboration

D Whitelock, E Scanlon and J Taylor, Open University

In recent years there has been an appreciation of the benefits that can be obtained by students working in groups or teams using computers. But there is a difference in opinion as to how a partner enhances learning and in particular how well adult learners do in the collaborative setting. In order to best capitalise on the opportunities offered by new technologies we need to undertake a more fine grained analysis of the process of collaboration and to recognise the affective factors which have been associated with cooperative learning. Our current research recognises that there is now a need to shift the unit of analysis for collaborative learning away from examining only task performance measures to examining student talk in terms of their joint activity.

This project is investigating adult learners solving physics problems with the aid of a computer simulation. We have chosen a non trivial task for the subjects to work with and that is in the area of elastic collisions. The basic research paradigm is similar to that developed by to pre-test subjects understanding of collisions followed by an experimental session where they work in pairs, problem solving with the aid of a computer simulation. Subjects are undergoing different experimental treatments while problem solving with the computer. These are: sitting side by side and working at a distance communicating with an audio link only. A delayed post test is administered and subjects experiments logged by the computer. All sessions are being video recorded and the discourse analysis will be linked to subjects actions. This will allow a more detailed form of analysis, as first described by Taylor et al, linking eye gazing, gesture and expression to subjects actions such as, checking, exploring, questioning and listening. The results from this study address the question of what sorts of technologies are best suited to match different educational objectives. It is timely to raise this issue since the sharing of limited resources is encouraged by economic and political pressures at all educational levels. This project is part of our overall research programme which is concerned with mediating science learning for distance learners with new technologies.

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Piloting a new approach; has the use of new technology improved the presentation of a distance learning computer science course?

Tina Wilson and Denise Whitelock, Open University

Projects using new technology are becoming of interest to all academic institutions in the UK due to economic pressure to increase student numbers without subsequent expansion in the staff student ratio. Papers have stressed the benefits to learners of using Computer Mediated Communication (CMC). These encouraging findings have suggested that distance learners would benefit from conferencing facilities. Studies have monitored student progress when linked by conferencing on a number of Open University courses such as a Lisp Programming course and an Arts course. This project ie STILE (Students and Teachers' Integrated Learning Environment) wishes to take the process one step further in the sense that undergraduate students following a Computer Science course will have conferencing facilities not only to be linked to each other but also to receive tutorial support and extra teaching resources online.

The STILE project started at the Open University at the end of March 1994 and set out to pilot the use of conferencing facilities on an already established high population undergraduate computer science course. The main aim of this project is to improve the presentation of the course by offering online facilities to a group of over 100 students taking the course in 1995. This is a significant number of students and we are interested to see how the more remote students respond to online tutorials, and how the extra teaching resources are received and can be refined.

The students are online and we are currently collecting data. This paper will present the preliminary findings of this study. The analysis will look at the quality and quantity of student interaction among the students themselves as well as with their tutor. The results from this particular study expect to support one popular view of the benefits of CMC which is "that students value the interaction with other students, as much as interaction with the tutor", and to report findings about the relationship between social interaction and work related dialogue. CMC is being used as the delivery mechanism in preparation for adopting the STILE software developed by our partners at Leicester and Loughborough Universities.

Customisable and interactive courseware

Conrad Wolfram, Wolfram Research Europe

New *Mathematica* technology is providing a mechanism so that interactive courseware can easily be built to make use of the computer mathematics engine. Students can work through active material, using a computation engine as the courseware and their abilities require, without having to learn the syntax of *Mathematica*. Graphics, descriptive text, animations, sound, a customised interface, selected possible functions and a student's own computations can all be available on one document.

These programmable documents can be made to change their structure automatically to react to inputs - opening up many possibilities for new styles of courseware. Structurally programmable documents offer a significant advance on current documents where just the content can be programmed.

This talk will present the new technology live, showing examples of its proposed use and its relation to other forms of electronic representation. Discussion and ideas will be welcomed.

Computerised summative assessment: a pilot study of interactive computer examination

Stan Zakrzewski, University of Luton

At the end of the academic year 1994 one hundred and fifty first year undergraduates underwent formal end of semester testing by computer using the Question Mark Designer software over the University's network. The assessment was for a module in Comparative Psychology which was largely taught by Open Learning texts. An important goal of the project was to explore the potential for a user friendly interactive method of testing large groups of students.

The results of the trial were extremely encouraging both in terms of the academic results and the student reaction to computerised examination. The Spielberger State

Trait Anxiety (STAI) test was administered to the students prior to the test and immediately afterwards in conjunction with a questionnaire concerning their reactions to this form of assessment.

Subsequently in February 1995 over seven hundred students took computerised formal assessment in the following modules from both first and second years:

- Management of Resources Allocation
- Understanding Government
- Cognitive Psychology

It is the combination of the pedagogic and psychological perspective that has made this research one of the first of its kind in the country.

The purpose of this proposal is to share our experiences at the University of Luton, with fellow members. More specifically:

1 *To describe the complete system and its evolution over an academic year*

- Software and hardware description.
- System configuration.
- System procedures at the University before the examination date.
- System procedures at the University on the examination date.
- Collating student answer files and the reporting mechanism.
- Contingency plans.
- Backups.

2 *To disclose the results of students response to computerised assessment*

The detailed feedback from the questionnaire showed that the great majority of students felt very positively about the experience and had not found it stressful. Indeed many expressed a preference for this manner of assessment as against the conventional paper based multiple choice test. From a list of descriptor words students most frequently chose to describe the Question Mark program as *flexible, interesting and easy to use*. A significant number of students felt that the computerised presentation and answering of questions had aided their examination performance and a few even went so far as to describe the experience as *fun*.

3 *To conclude with a critical evaluation and a vision for the future.*

- Establishment of user groups.
- Sharing question banks over the Internet.

A study of the use of an online learning resource for art and design students

Zhengmai Zhao, John Cook and Nick Higgett, Leicester De Montfort University

We have recently developed an online learning resource on contemporary crafts based upon a platform provided by STILE (Students' and Teachers' Integrated Learning Environment), a TLTP project. The main idea of this work is to facilitate student centred learning, focusing on Art & Design subjects, by taking advantage of the latest IT advances in areas of hypermedia, image processing, and computer networking. The learning resource comprises lecture notes, information about the lecturer, bibliographies, and a large number of images, which are very important for students to understand the subject matter, but to which students had previously only a limited access. The online resource is organised in a nonlinear fashion. Students are allowed to browse the resource base at will by means of hypertext links and to retrieve information by using searching facilities provided by the system. The resource is cross-platform accessible. Students can access it through most types of computers (eg PCs, Macs, and UNIX boxes) at any location as long as the machine is connected to Internet.

In order to see the effectiveness of this online resource, thus finding a most appropriate way to incorporate it into our pedagogical practice, we are currently conducting an exploratory field study. Twelve undergraduate students who are taking the course Contextual Basis of Design and assigned seminar presentation topics related to contemporary crafts participate in the study. They are introduced to the online system and advised to use it to prepare for their seminar presentations. A multi-faceted approach to evaluation is employed in the study. The effectiveness of the online resource is being assessed from several different aspects including outcomes from using the resource,

processes of interacting with the system, and attitudes towards the innovation. The data collection methods used in the study include observation, interview, questionnaire, user usage log, and conventional learning assessment methods (eg seminars, essays, exams).

The full paper presentation will consist of four sections: introduction, overview of the resource base, method used for the study, results from the study, and conclusions and discussion. In the last section, we shall address some issues raised from the current study such as demand for the development of new strategies for teaching and learning with the emerging technology, and importance of infrastructural support for such technology-based teaching and learning.

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The Aberdeen Bestiary Project - using the WWW to increase access

Michael Arnott, Iain Beavan, Michael Craig & Jane Geddes, University of Aberdeen

The Aberdeen Bestiary (Aberdeen University Library MS 24) is considered to be one of the best examples of its type. The manuscript, written and illuminated in England around 1200, is of added interest since it contains notes, sketches and other evidence of the way it was designed and executed.

However since the manuscript is so rare and precious access has to be strictly controlled in order to protect the manuscript from damage. The aim of this project is to produce a digital facsimile of the manuscript which can then be made freely available to the UK higher education community and beyond.

To reach this goal a combination of two technologies have been employed. Firstly the Bestiary has been photographed and these images transferred to Photo CD to produce a digital archive. The major benefit of using the Kodak system is each image is stored in five resolutions (ranging from 128 x 192 pixels to 2048 x 3072 pixels) thereby permitting flexible use of the image resource without the need for re-photographing the original material. Secondly to give maximum access to the digital facsimile the material has been mounted on the World Wide Web. By judicious use of the varying image file sizes from the Photo CD and image mapping it has been possible to produce a visually rich and detailed interpretation of the Bestiary while constraining file sizes so that the resource performs well at a remote site.

Additional material is included with the electronic Bestiary to develop the facsimile into a globally available learning resource. This includes a search engine, a complete translation of the Latin text as well as a commentary by an art historian. A facility to request hard copy prints of individual pages will be included in the final version. These will be produced from the Photo CD archive.

By utilising the approach outlined above we believe that the Bestiary site is an effective learning resource and not just another electronic exhibition.

A computer based introduction to learning skills

Paul Bailey, University of Plymouth

The Learning Skills Package is a screen delivered interactive computer based learning application, running under Microsoft Windows on a Personal Computer. The Learning Skills Package is designed to be used as a flexible learning aid, in conjunction with existing Learning Skills material.

The content of the package is designed to help the users to explore and evaluate their own approaches to learning and to encourage them to become more effective and efficient learners. The emphasis of the package is on the user finding their own strategy, as well as giving positive ideas and approaches to develop skills. The user is required to actively participate when using the package, by answering questions, completing activities or selecting options based on their own experience.

Modules included in the package are:

- Studying in Higher Education
- Improving Reading Effectiveness
- Managing your Time
- Planning and Writing Essays
- Learning from Lectures
- Preparing for Assessment

Further Modules are being written to look at Research Materials for Assignment and Writing Skills

Customisation

To be wholly effective the package needs to be flexible in its design as well as its use. The following features are being included which may be customised as required:

- Information on further support available in the University - this will include details of forthcoming skills workshops.
- Skills development resources available.
- Text file versions of skills leaflets, etc which can be copied to a disk (to be printed later) or viewed on-line and annotated by the user.

- Further development exercises which can be copied and printed by the user.

The package also needs to be made widely available and accessible to everyone. There is no reason why this package cannot be made available to students to run on their own PCs as well as being networked throughout the University.

Integration and application

The package will be fully integrated into the University in September 1995 and we have identified a range of ways the package will be used:

- Integration into existing Learning Skills Modules within Departments
- As an Open Learning Resource for students entering Higher Education
- As a basis of a Learning Skills Module for Departments introducing Skills Development for the first time
- To support tutorial programmes looking at Skills Development
- As an Open Access resource for all students at the University

Evaluation has so far given us valuable feedback and we are pleased at the positive response from both staff and students at the University. This has helped shape the package and will continue to do so in the future.

Contrasting development of two commercially sponsored computer-based learning applications in the life sciences

Brian Boullier, University of Bradford

Our degree programmes rely heavily on laboratory-based teaching to facilitate practical understanding and competence that complement the detailed theory provided by student participation in lectures, workshops, seminars and tutorials. However we are also faced with the need to effectively and positively manage the demands of increasing student numbers, whilst continuing to provide quality and modern teaching in the Biomedical Sciences.

Our undergraduate students, having benefited from an introductory module entitled 'Computers & Communication Skills', are encouraged to use personal computers throughout the course. They also frequently encounter PCs in laboratory classes where they often augment and occasionally substitute for conventional methods.

Two newly developed applications are presented. Differing in scale and construction, they have both been designed to meet very specific educational needs. The first application, developed in collaboration with Anachem Ltd, is designed to demonstrate the correct operation and maintenance of the Gilson laboratory micropipette, a widely used, yet often abused, item of laboratory equipment. PictureBook authoring software was used to create an interactive tutorial which uses still graphics and simple animation to clearly illustrate correct operation and usage of this apparatus. This software shall be used to enhance student learning within an existing 'Essential Laboratory Skills' module and may be distributed commercially.

In contrast the second application to be demonstrated, entitled 'Essentials of Cell Culture', offers a comprehensive introduction to technologies exploited by this increasingly important discipline. Developed in collaboration with Catalyx Systems, an Ohio-based company to which the author is also scientific advisor, this interactive training guide was created using Authorware Professional and integrates many video and animation sequences as well as a large selection of still images to introduce and explain the basic skills and fundamental techniques associated with successful cell culture. Clear navigational aids, extensive hyperlinking, printable protocols and detailed libraries of up-to-date information are easily accessed throughout the application. This application shall be commercially marketed.

In conclusion, it is our experience that commercial sponsorship, aided by clear and realistic project planning, can greatly assist in the development of new CAL materials of value in higher education.

An audience response system

D Brough, Manchester Metropolitan University

The large number of students currently found in many lectures has inevitably reduced the level of staff students interaction. In many cases, students are intimidated by the

crowded rooms and fail to respond to even simple questions. Various strategies can be adopted to help overcome these problems but for the most part they provide only qualitative feedback and do not necessarily engage all the students. With the audience response system all students actively participate and quantitative feedback is generated.

Each student is provided with a hand set which is linked to the PC. Prepared on ad hoc questions are displayed via a PC projection system, using one of a library of question formats. Each student registers her/his answer by means of the handset and once all have responded the correct answer is displayed together with some graphical image showing the overall class response. Individual scores can be analysed and stored. The instant feedback gives added interest, it reinforces correct answers and puts right misunderstandings. Everyone has to participate not just the keen few in first 3 or 4 rows. Students are encouraged by being able to test themselves anonymously against their peers and academic staff can quickly judge the effectiveness of their teaching.

The current system is cable based but an infrared system is being developed which should improve the ease of use in the future.

Mass distribution of interactive tutorial software

Harry Burley, La Trobe University, Victoria, Australia

The personal computer is now widely available in the homes of students or of their friends. For large first-year classes in the subjects of Management and Marketing we have published software, through Prentice-Hall, to provide interactive electronic tutorials for students to recapitulate or test themselves in textbook knowledge without requiring either manpower supervision or limited space in University computer laboratories.

For each subject the software, home authored in C, provides about 720 multiple choice questions, with answers (after correct student answer or two incorrect responses), together with up to 7 lines of text detailing reasons for right answer and detailing text page preferences.

We have retained text mode throughout and DOS delivery to enable such extensive information to fit on one 3.5" (floppy) disk and for the software to be deliverable on the general sort of personal computers available to students. The disks are sold shrink-wrapped with the textbook or as a separate package at an inexpensive price of about £10. This mode has been found very practical for open learning classes and for student guided learning.

We are investigating developments along the lines of InterNet distribution, paperless exams and delivery across virtually all operating system platforms.

The role of computer simulations in quantitative science courses

S C Busbridge, University of Brighton

Computer technology has now advanced to the stage that high quality computer simulations can appear to be a frugal alternative to laboratory based experimental work. The student experience in a typical simulation is illustrated in Figure 1. Students explore the algorithm (ie the object simulated) by repeated feedback between the input and the output, which can be anything from simple text to a high quality graphics interface producing a life-like image of the object simulated.

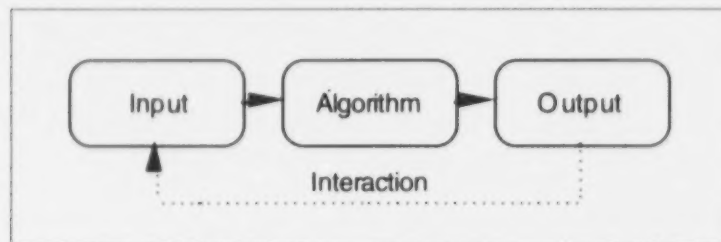


Figure 1: The student experience in a typical simulation

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Unless the virtual environment is so close to the real environment that all of the skills required to effectively exercise real world experimentation are called upon, simulated experiments will always suffer from the lack of a dimension. Even if this is not the case, to use the virtual world to educate students in scientific methodology must be treated with great care; for the object of all science is to discover the unknown, and that which is not known cannot be simulated.

Once it is clear that all but the best simulations are not replacements for experiments, their role is drawn into question. The distinction must be made between *training* students to become proficient in a particular situation (eg flight simulation) or conversant with a certain physical law, and *educating* students in that particular discipline.

Computer simulations are very good at providing a short-cut between the experimental objectives and the results, but they are not yet good at replacing the experimental process itself. The paper concludes with a demonstration of a simulation of X-ray diffraction written and used by the author to teach the underlying Physics of the experimental technique. It is shown how such a simulation can be used to teach concepts and why it is poor at teaching experimental method, even although the output of this particular program is very life-like.

Multimedia guide to library business databases

Helen Butt, Andrew Dunne, Paul Horbury, Steven Miles and Elizabeth Wylie,
University of Huddersfield

Rationale

The University library information desk staff are constantly required to answer a series of repeated, elementary questions referring to their paper-based and computer-based business databases. A multimedia guide has been devised to respond to frequently asked questions in order to free library staff from routine enquiries and enable them to attend to complex, individual queries.

Background

The University of Huddersfield Library, with the aid of Enterprise in Higher Education funding, has instigated a one year project to design, produce and evaluate a multimedia guide to library business databases intended for use with higher education students.

A mini-business has been set up with the University library as clients and students at the University Multimedia Unit as producers. A research assistant has been employed to oversee and manage the project. Representatives from both the Library and Multimedia Unit as well as external commercial contacts have worked collaboratively to inform the design and production of the application.

Production methodology

Students pursuing the MA in Interactive Multimedia at the University's Multimedia Unit have been engaged in researching the implications of such a system and in developing prototype material. This material has been assessed by both library staff and external commercial consultants. The application is currently in the final stages of production and will be tested by undergraduates on the Business Studies degree course at the University in June. Results from these tests will be evaluated and the appropriate adjustments to the application will be carried out by the end of July 1995. It is envisaged that the completed application will be running in the library from this time and will be subject to further evaluation when the next academic year commences. The application will eventually be networked.

Let the software do the work for you

Harriet Butterfield, Dorset Business School

Of particular interest to university teachers using technologies, senior managers responsible for IT in teaching and training, courseware development project directors, multimedia developers and producers and educational development support staff.

SVAO (système video assisté par ordinateur) is a software package which enables the university teacher to take - simply, quickly, easily, - existing commercial video-cassette programmes or specially-scripted video-cassette programmes and make them interactive by stopping the film and superimposing an interactive text frame. There are 4 basic forms of interaction:

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- multiple choice questions
- true/false
- textual input
- key words

A further facility enables the university teacher to identify who used the programme, and with what result.

The software, currently available in the version MS-DOS + Video-Cassette, will shortly (Summer 95) be available to run on Windows, and use CD rather than video-cassette.

SVAO has the advantage of being cheap and cheerful, easy to customise, easy to adapt. Simplistic in terms of visual appeal, the software/video cassette combination allows the university teacher to create short, simple explanations, demonstrations, case-studies, questions etc to reflect basic knowledge required by learners.

It is particularly effective in two areas:

- as a way of managing different levels of knowledge within groups from different knowledge backgrounds, eg a management programme where students have differing levels in accounting, business, technology.
- as a way of exploiting foreign-language programmes to facilitate understanding, to focus on use of the language, to identify grammar in action.

The *benefit to the learners* lies in the opportunity to study, consolidate revise at one's own speed.

The *benefit to the teachers* lies in the opportunity to put key basic areas on knowledge into a readily accessible format and so free time to devote to more sophisticated issues.

Migrating molecules and moving muscles: learning about the peripheral nervous system via the moving image

Emma Candy, Jonathan Elliott, Fiona Cunningham, University of Edinburgh

Veterinary students sometimes find it hard to relate their physiology and pharmacology studies to the clinical practice to diagnosis of disease and drug therapy. "I'm only interested in working with animals, why do I have to learn all this science? Do we really need to understand this?"

When the curriculum of the Veterinary Basic Sciences course at the Royal Veterinary College, London, changed from a traditional lecture/practical based course to an PBL (Problem Based Learning) course, including self study and group problem solving units, there was a need for teaching and reference materials which could be used at times convenient to the student. It was also recognised that the students found some of the concepts and processes involved in the workings of the peripheral nervous system difficult to visualise through lectures and handouts.

As a result a CAL program was developed at Edinburgh, via the CLIVE project, to be used in all the UK vet schools, using animations. This demonstrates the physiological processes at work in the peripheral nervous system. It allows the students to try out different drugs at various stages of the transmission process to discover the effect they have both at a molecular level and on the whole. It is a structured teaching package which aims to give the students an integrated view of the system and incorporates clinical cases where the students can test the knowledge they have learned in a group or on their own.

Issues of how the moving image can aid understanding and the approach taken to structuring the visual material are addressed. Also, observations regarding interactivity are made; how much should the student sit and watch and how much should they learn by trial, error and discovery?

Modelling a leisure centre information system using MS Access 2

Sue Coles, Manchester Metropolitan University

It has been noted both by the world of business and of information systems that students of either discipline could benefit from more experience of the other as most businesses use information systems. One of the main subject areas at Crewe+Alsager Faculty is Business and Management studies. Students are now being offered more options in information systems to help fit them for a world of Business Information Systems.

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These options have a large theoretical content and it is desirable to introduce elements of a more practical nature. It is difficult to look at information systems 'in the field' so to speak and the creation of simulation models is seen as one method of addressing this lack.

The model that is to be demonstrated is based on a relational database, created using MS Access, which concerns the membership of a small leisure centre and the use of its facilities by the members. The model is the implementation phase of the systems development life cycle for this fictitious leisure centre. It also aims to demonstrate, practically, how simple management information may be derived from the membership and facility usage data.

Accommodating multiple learner styles and multiple disciplines in a single multimedia learning resource

Roy Currie, University of Central Lancashire

The LANCAL (Lancashire Computer Assisted Learning) system has been designed as generic multimedia delivery tool suitable for the development of computer assisted learning materials in a wide range of subjects. LANCAL employs a highly modular architecture, with components for the structured presentation of course material, hypermedia networking of course material, on-line assessment and learning needs advice, content browsers and a suite of customisable interactive components for subject specific learning activities.

The system is currently being employed for the production of 11 CD ROM titles on introductory marketing through the UK centrally funded Teaching and Learning Technologies programme (TLTP), 3 CD ROM titles on waste management through a EU funded EUROFORM project, and titles on midwifery and psychology through internal initiatives at the University of Central Lancashire. A suite of tools is under development to provide assistance to academic staff who are producing learning materials for delivery with the LANCAL system.

LANCAL has been designed for speed and efficiency in the production of computer assisted learning materials. Media production overheads are optimised through the use of media items in multiple contexts eg an image can be used as an illustration in a tutorial, an annotated node in the hypermedia network and linked to a test item in the assessment section. All LANCAL titles are media rich, containing in the order of 70 minutes of video clips, 200 images and graphics, 110 multiple choice question items in addition to large volumes of text.

Support for multiple learner styles is achieved through the dynamic way in which the learner can move between modules. This enables the conservative learner to be highly supported in structured tutorial sessions, while adventurous learners can navigate freely through the browsers and hypermedia networks. Systematic learners can use pre-test facilities and then follow the system's advice regarding the sections of the material to which the learner should pay most attention.

Current development work on the LANCAL system is focusing on implementing the findings of the evaluation studies performed with the marketing and waste management students, enhancing the interface and adding further plug-in interactive components.

SMARTLAB - software for teaching mechatronics

Ian Every and Geoff Austin, Open University

Software-related activities are a key to part of a new third-level Open University course on mechatronics called T395 - *Mechatronics: Designing Intelligent Machines*. These activities explore topics in the areas of perception, cognition, scanning, neural networks, searching, scheduling, knowledge-based systems, fuzzy-logic and intelligent control. Eight major software packages have been developed by the Educational Software Group at the Open University in collaboration with members of the team developing the rest of the course.

The software demonstrated will include a neural network system, and what has been called a blackboard system. The latter allows multiple rule-based systems as well as procedural tasks to run concurrently and communicate with each other. The main course project uses this software to allow students to achieve intelligent control of an

autonomous vehicle via an infrared link. Further programs enable students to explore a famous control problem (balancing a broom on a moving trolley) as well as a range of optimisation and search algorithms.

The software was developed for Microsoft Windows using Borland C++ and Open Win - a powerful Windows class library developed by the Educational Software group.

Developing critical and analytical skills in the teaching of photography

H Freeman and Greg Lucas, De Montfort University, Leicester

This paper describes a new way of developing critical and analytical skills in students taking the level 1 module 'Seeing and thinking photographically'. Whilst there exists much software which describes and demonstrates the use of the camera there is little that directs students to the aesthetics of composition and form in photographic images. The software described here attempts to redress this balance.

The software has two components: the default mode enables the student to examine any one of 50 black and white photographs. Each photograph is categorised by a photographer using terms such as candid, movement and scale, and then classified by up to 20 further terms such as 3D flattening, pictorial space, creating rhythm and reflection. Students are encouraged to browse the images and compare their attitudes about the photographs with the fixed categorisations and classifications of the software's authors.

The second mode of use is the 'Assessment' mode, where a random subset of images are presented to the user with the request that they perform the image classification. At any time they may compare their opinions with those of a subject specialist and receive a comment about each criterion they used, together with a short critique of the image.

The criteria used in the programme are the same as those used in the description of the main assessment project for the module. Students are encouraged to use the software in small groups throughout the module and particularly prior to and during their selection of images for submission for assessment.

Future developments will include an interactive composition/cropping component that will allow the student to manipulate the image, albeit narrowly: for example, to crop the image, to change the contrast, to 'remake' the image to satisfy a set of requirements defined by the authors or identified by the student. An essential component will be the informed comment that is returned to the student.

The application enables students to compare their analysis with that of a professional photographer without the constraints of time and access inherent in conventional teaching: seeing and thinking photographically.

The Homer Project

Joel Greenberg, Peter Wright, Open University

The Homer Project is an attempt to solve a group of problems that arose out of trying to teach at a distance an interdisciplinary arts courses A295 Homer: Poetry and Society. The project work is based around six weeks of study and assumes that the student has already completed the first six weeks of study on the course.

Each week of study consists of a number of interactive activities which are supported by CD-ROM based resources such as texts, still images, audio and video clips. The resources are held in database form and are accessible directly by the user.

The project is a real example of integrated multimedia teaching and should prove invaluable to the higher education sector. In particular it has shown how the multi-disciplinary team approach can be effective in developing teaching material of this kind. It has also shown how the new technologies allow us to move away from the narrative form of teaching and give the student more control over their learning environment.

CAL on the World Wide Web

Lee Griffiths, University of Salford

In the Department of Physics at Salford University we are currently developing a

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Distance Learning module in Statistical Thermodynamics at Masters Level. This proposal offers a software demonstration of Statistical Thermodynamics CAL software developed for the WWW. The demonstration will show the benefits of using the WWW for Distance Learning and CAL generally, as well as offering *hands on* evaluation by attending delegates. The demonstration would ultimately require a ISDN link to the Internet to exhibit the benefits of the Internet for CAL, although the software could be run locally. The services offered by the Internet are often demonstrated at conferences, but the practicalities of its use are often overlooked. This demonstration would give an insight to the level and cost of technology required to realistically set-up a course via the Internet.

The use of small, locally developed software packages to replace selected chemistry laboratory experiments

Simon Hall, Manchester Metropolitan University

Several computer packages have been developed to support the teaching of Physical Chemistry at the Manchester Metropolitan University. The software packages have been developed for use on IBM PC type computers with the Microsoft Visual Basic language. This has enabled students to operate the software within the graphics-oriented WINDOWS environment.

These packages are used to simulate a number of laboratory experiments. The policy is to simulate only those experiments which are either too hazardous or too time consuming to be undertaken satisfactorily by undergraduate students - it is not the intention that such packages replace all laboratory experiments.

One package simulates the primary data for measurement of heat capacity using the National Physical Laboratory method. The student fixes the current and heating time for the simulation of electrical heating of a sample within a. A plot of sample temperature as a function of total heat energy is displayed progressively during the heating process. This data is exported to a plotting package where the student is required to determine the heat capacity at each temperature, identify any phase changes and determine the entropy.

Three other packages will also be demonstrated; two packages deal with the simulation of cooling curves for the determination of eutectic and congruent compositions of two-phase systems and the remaining package simulates the titration of mixtures of strong and weak acids with a strong base.

Laboratory simulations in molecular & cell biology

J A Hamnett, K R Mitchelson, M J Cornish & C K Pearson, University of Aberdeen

The use of the laboratory simulation is proving an attractive feature in the undergraduate courses in our department. Clearly these cannot teach practical laboratory skills, and are not presented to the students as if they can. However, we can simulate more complex experiments than would be possible given the time and resources allotted to a laboratory class. This aspect, and the ability to be able to use the programs in an exploratory, interactive way renders the CAL package an ideal supplement to other teaching modes.

The students also learn many skills that they would gain from a wet laboratory practical, in terms of intellectual challenge, development of analytical skills and the subsequent experience of presenting an attractive and accurate written account of their work. Here they can use the word-processing, spreadsheet and graphics facilities of the computer to the full to present professional-looking documents.

Two new programs available for the first time in 1995 will be presented. These are:

- 1 Chloroplast Genome Organisation and
- 2 Hormone-Receptor Binding: Scatchard Analysis.

The *Chloroplast Genome* program teaches students fundamentals of how modern molecular biology techniques can be used to locate the position of genes on the chloroplast genome. Procedures are illustrated with the aid of simple animations and diagrams. Once students have been through a tutorial, which illustrates the genome mapping procedure, they are given real experimental data to analyse and locate the position of gene sequences on the lettuce chloroplast genome. The program is divided into sections: AIMS, LIBRARY, LABORATORY, LABBOOK and HELP.

Hormone-Receptor Binding. The Scatchard equation is universally used to plot experimental data regarding hormone and growth factor-receptor binding in order to obtain information about hormone/growth factor binding affinity (K_d , the dissociation constant) and the number or concentration of binding sites (n). In this program the students are first guided (line by line) to derive the appropriate form of the Scatchard equation for themselves. They then go on to analyse experimental data using a spreadsheet and manipulate the data to a form which can be plotted according to the Scatchard equation. The program contains substantial help support.

Student responses to questionnaires reveal a positive attitude to this complementary learning experience, although many of them feel that too much CAL may limit their acquisition of laboratory skills.

Cooperative cross-platform courseware development: software demonstration

R D Harding, S W Lay and H Moule, Cambridge University

Of all the TLTP Projects, the UKMCC has involved the largest number of institutions in authoring courseware. This was part of a deliberate attempt to set up an 'open courseware system' which can continue to be adapted and grow even after the end of TLTP funding. In turn, such an objective requires a cross-platform approach to courseware development.

By the time of the ALT-C 95 conference, nearly 30 modules will have been completed by authors from over 20 institutions. The writing of a further batch of up to 20 modules will be under way. The authors will describe how the UKMCC has tackled its basic objectives, and raise important issues for the future of courseware, how it is designed, written and used. There will be a brief outline of the structure of the UKMCC, with its distributed management system and Resource Centres. All the authors' names and institutions will be acknowledged. The presentation will focus on three major issues:

Who writes courseware? Academics or programmers? What are the implications for courseware design? We will refer to earlier work, the need for templates, and a 'kit of parts' approach.

Learning style. How will institutions use Mathwise? Will it replace any 'live' lectures? Is it just remedial?

The future of Mathwise. There are two sides to this issue. One is simple: is there a complex future, and can courseware writing be self-financing? The other is complex and more significant for the academic community: what incentives, professional and material, will there be to write courseware? The confusion in HEFCE over the status of courseware development in the Research Assessment Exercise is noted.

Many other issues arise, amongst which the following will be briefly discussed:

- The need for a Courseware Design Specification to ensure uniformity of standards and help provide author support.
- Conversion of courseware across platforms.
- The use of self (formative) assessment, and monitoring summative assessment in courseware.
- Navigation: the development of an 'open system' Courseware Manager.
- Locked media and network delivery; a technical problem which has strong design consequences.

A tool for automated criterion referenced marking and modular administration in higher education

John Hassall and Ritchie Macelfield, Wolverhampton Business School

The Assessor Project

Whilst most academics are able to boast access to a personal computer, it seems that significantly less investment has been made in the area of automating fundamental tutoring tasks such as marking, feedback, grade collation and moderation. Such tasks can be facilitated by use of wordprocessors, spreadsheets and simple personal database applications. However, the nature of learning provision means that some interaction is required between and among tutors and with the central administrative systems. Such interaction is often inefficient and frustrating for all concerned; relying as it

does upon paper based systems and discrete computer programs.

The Assessor development at Wolverhampton Business School is aimed at automating a large part of the *front end* processes concerned with marking, feedback and collation of marks for students within the context of a large modular course structure. A process of criterion marking is applied so that the tutor will mark students work on the basis of atomic criteria applied to each unit of assessment. The calculated overall grade for each unit of assessment is automatically generated, together with high quality structured feedback to the student.

Business benefits

Assessor is not designed to increase the actual speed of traditional marking (use of the red pen!) its benefits lie in the areas of increased quality, automation of grade manipulation following marking and management information.

Assessor quality benefits

- Standard marking criteria
- Grade scale standardisation
- Faster student feedback
- More student feedback
- Higher quality student feed back
- Consistent subject recommendations and moderation in subject boards
- Elimination of rounding errors in grade calculation
- Elimination of transposition errors
- Production of comprehensive statistical data

With the intention of demonstrating some of these the software exhibit will:

- Demonstrate the Assessor software used for marking and feedback.
- Demonstrate the use of Assessor for preparation of marking statistics and moderation.

A way into multimedia courseware development

R Hasson and J Manners, Open University

In the paper we will discuss a very natural strategy for increasing multimedia awareness and development skill within a department. This consists of forming small 'project teams' of one/two lecturers plus one multimedia author to tackle well defined subject areas with the aim of producing packages of approximately one to two hours student time. This contrasts sharply with the policy that new courses should be substantially multimedia led and forming a large (and essentially novice) team to implement it. In our model the existing courses gradually evolve towards being multimedia led. More ambitious projects could then be tackled as expertise grows.

The authors have followed this strategy to produce CAL exemplar programs by choosing promising areas from the current Open University undergraduate programme. The first project was to enhance the quantum mechanics in the basic physics course (S271: Discovering Physics.) The second project was to explain the wave-like nature of matter in a way accessible to students of the science foundation course (S102.) The software from this last project is what we propose to show at the conference.

The software runs under Windows 3.x and is generated using the latest software tools available (eg Multimedia ToolBook 3.0 and Visual Basic 3.0.) The software exemplifies our approach to CAL software that is intended for self study: keep the interface simple and intuitive (although strictly adhering to the windows interface guidelines so that regular computer users are not misled.) The software produced contains three elements: a multimedia glossary, several CAL based tutorials and a computerised assessment package (both formative and summative.) When assessed in formative mode the student can be directed to relevant material for help.

Language learning at a distance in virtual reality mode

M R Jones, W Norris and D Simpson, University of Ulster

This project exploits both long-established and emerging technologies in order to create a new distance learning environment, designed to assist modern languages teachers to create both a more flexible teaching and a more varied learning experience for their students.

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Over the last decade Languages Resource Unit staff at UU have been exploiting the potential of integrated video systems in the language laboratory. Since 1990 technical staff in Educational Services in Ulster have been researching into the use of studio-based video-conferencing within distance teaching and learning.

A joint project team was formed and approaches were made to Tandberg (UK). The basis of the project was the design and testing of a 'Telematic Interlink Control System' utilising ISDN digital technology and 'Tandberg Multimedia Centre Control' software. The control system as envisaged would enable 'full video' or 'virtual reality' distance teaching to be carried out between sites at remote locations, employing the Tandberg IS10 laboratory as the basic teaching vehicle. The mark 1 version of the system, allowing the bi-directional exchange of video, audio and language laboratory function control signals between remote sites, was publicly demonstrated for the first time last September at the Paedagogische Hochschule in Karlsruhe, on the occasion of the EUROCALL 94 conference.

The pedagogic exploitation of the new links is currently concentrated in two differing directions. On the one hand, the project has now made it possible for a teacher to control and teach from his/her desktop a language class seated in any suitably - and inexpensively - modified Tandberg IS10 language laboratory, a large number of which are already located not only throughout Europe but also literally all over the world. On the other hand, work is in hand with the aim of linking any two or more suitably modified IS10's in order to enable, for example, a group of students of English at the Free University in Berlin to work together with a group located at the University of Ulster, with the aim of producing a model translation of a given text. This system could, however, equally facilitate a multi-site seminar on coastal erosion for groups of geographers located in different countries.

The associated demonstration would allow delegates to practise distance control of the language laboratory in Coleraine.

Resource based learning environment for THD204 Information Technology and Society

Karen Kear and Mark Jones, Open University

THD 204 is an inter-faculty course that explores some of the main social and technological issues surrounding the introduction of information technology into our everyday lives. Students studying the courses are sent CD-ROMs which give them access to a wide variety of carefully indexed textual, graphical and audio reference material as well as to computer-based learning materials that support and enhance the text. Students also are given access to a computer-mediated conferencing system and the Internet.

A resource based learning environment has been developed to provide a graphical user interface to the CD-ROM based materials and the demonstration will show how students use this environment to access the resource material. It will also show how the students use the conferencing system and the Internet.

A graphical cross-platform toolkit for interactive educational applications

S W Lay, R D Harding and M R Manning, University of Cambridge

The project has taken a step towards solving the 'cross platform authoring problem' by building a set of tools which cover standard tasks required by scientific software on a modern operating system. These tools, collectively known as the Scientific Programmer's Object Toolkit (SPOT) can be used from developmental projects on Macintosh, Windows and X-Windows systems.

SPOT provides tools for:

- 2D and 3D graphics (including output to standard formats)
- Evaluation and pretty-printing of user-type expressions
- Standard numerical algorithms
- Easy integration with user interface tools
- Cross-platform file formats
- Client server operation

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The project will be completed in April 1996. However, a number of programs developed with a pre-release version of SPOT will be demonstrated at the conference.

A particular challenge is to illustrate documents written using HTML and presented via the WWW. Since SPOT allows information to be transmitted across platforms (and hence across the web) without additional effort, objects (such as graphs or lists of data) generated remotely can be manipulated locally. An extract from a web-based interactive text on numerical analysis which uses this feature will be demonstrated.

In general, the increasing use of hypertext authoring packages has fuelled the demand for tools such as SPOT. For example, an XCMD (external command) written to supplement courseware written in Hypercard cannot be fully converted to a DLL (dynamic-link-library) for use with the ToolBook. Cross-platform authoring tools, eg Authorware Professional, have accentuated this need. Our ultimate goal is to provide 'software glue' to enable SPOT to be used from as wide a range of authoring tools as possible.

Guidelines for effective collaboration in developing and using learning technologies

Janet Lewins and Barbara Watson, University of Durham

The Teaching Technology Initiatives team (TTI) have collaborated with a variety of departments to integrate IT into the curriculum. Our experiences have led us to develop the following stages

- | | |
|---------|--|
| Stage 1 | The two parties are apart
<i>Identify educational objectives</i> |
| Stage 2 | Increase the academic's awareness of the variety of CAL materials and possible educational applications
<i>Break to stage 5 if existing CAL is appropriate</i> |
| Stage 3 | The two parties are in unison in their goal
a) The academic analyses and visualises the subject material and develops a mental image of its structure in order to focus on the educational objectives
b) TTI develop their understanding of the educational objectives and interpret them through the appropriate development tool |
| Stage 4 | The size of the intersection between the two parties is dependent on the academic commitment.

Collaborative development cycle of the project including design, implementation, testing, delivery and evaluation. |
| Stage 5 | Integration into the curriculum. |

The success of *all* stages is dependent on good communication and an understanding of mutual requirements needed to achieve a single goal.

Academics who merely want to use 'CAL for CAL's sake' do not complete Stage 1.

The progression of an academic in Archaeology, with no previous knowledge of CAL, through Stage 2 to Stage 3, enabled TTI to work with him to develop courseware on the Physical Geography of the Mediterranean.

In preparation for a departmental test, a General Knowledge Test has been written in Question Mark Designer for Windows to enable the students to attempt the different question types. Delays in Stage 3a could be due to working with a group rather than an individual.

A successful collaborative development cycle in Stage 4 through regular meetings and communication, resulted in the efficient production of the interactive University Library Guide.

Effective collaboration with the Geology Department, through Stages 1 and 2 and breaking to stage 5, resulted in the use of a TLTP product.

These guidelines for effective collaboration are the direct response to the strengths and weaknesses encountered during the development of several projects.

A demonstration of computerised lectures notes for staff and students

Jon Lyons, London Guildhall University

1 Introduction

- 1.1 A decision was made in the Summer of 1994, by the Faculty of Business at London Guildhall University to amalgamate all first year accounting courses, leading to a course of 700 + students over two semesters.
- 1.2 The author was given the task of preparing a course of thirteen lectures to be repeated three times in two semesters.
- 1.3 A decision was made to write the lectures on Microsoft Powerpoint to use the excellent presentational facilities available at the University.

2 The University and the Students

- 2.1 The University is multi-sited in the City of London. Approximately six lecture theatres of capacity to 180 are fully equipped with Barco presentation facilities, which enable colour graphic projection, from a portable computer on to a screen of six feet by four feet.
- 2.2 The University also has an excellent computer network, which supports the same software as the Barco readers.
- 2.3 The majority of students are from a local catchment area, thus from deprived inner city boroughs - what the author has dubbed the 'Nintendo generation.' It was felt that in order to be successful the lectures would have to be lively and entertaining, hard for accountancy!
- 2.4 Due to the course amalgamation, the students came from a variety of degree course such as Law, Economics, Accountancy, Financial Services and European studies.

3. The Material

- 3.1 The material to be presented consists of the lectures used and repeated seven times during the academic year.
- 3.2 There is additional material of a new series of lectures covering basic management accountancy and a multiple choice question bank for the student's own use.
- 3.3 On average a one hour lecture consists of fifteen overheads, these may be accompanied by handouts.
- 3.4 The lecture notes on computer disc may be made available to students and other institutions for a reasonable fee.

Internet courseware at Staffordshire University Business School

Kevin Macken and Ken Randall, Staffordshire University Business School

Much of the Internet courseware in use at the Business School is not available outside of Staffordshire University so this is an opportunity to display it to others.

All the courseware being demonstrated will be both completed and available for use throughout our University's Internet classrooms.

A computer aided assessment system and its use in Earth Sciences

Don Mackenzie & Helen Wilkins, University of Derby

Computer aided assessments have been used in the Division of Earth Sciences at the University of Derby since 1989 with student groups of up to 180. The Division currently uses six computer aided assessments which have partially replaced traditional coursework assessments in its degree courses.

The production of these assessments has resulted in the development of a Computer Aided Assessment System which comprises an Assessment Engine, Question Jig and an increasing number of Question Templates covering many different types of question which can include graphics and user controlled animations.

The Question Jig and Question Templates allow the relatively rapid input of new questions which are saved as individual question files. The Assessment Engine handles the sequencing of questions, scoring and filing of results. Options to allow re-answering of questions and cycling through the assessment until all answers are correct are also available to the tutor. Results output files are fully configurable by the

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tutor who may also choose whether or not to display the results on-screen to the student at the end of the test.

The system can incorporate a 'Screen Microscope' which encompasses most of the facilities of a standard petrological microscope but displayed on the computer screen. The Screen Microscope forms an integral part of the assessment so that students may use it in the same way as they would a standard microscope when answering questions.

The demonstration and posters will show typical outputs from the system and a range of different question styles.

The system is applicable to almost any discipline and has been recently used for assessing students in the School of Business at the University of Derby in addition to those in Earth Sciences.

Teaching - learning and the role of objectives: a CAI-CAL package

Madhumita and K L Kumar, Indian Institute of Technology

This paper describes a CAL - CAL package developed for faculty development in higher education under the Modular System of Staff development Project. The package attempts to present some reflections on the processes of learning and facilitation or creation of learning. This CAL-CAL package has been developed using 'Leprof' as the authoring platform and incorporating Turbo C in order to make it more interactive. This package has the special features incorporated in it for presentation/single user/group of users. The package allows the presenter to use different highlighting techniques while presenting. It allows man-machine interaction and also interactions among the learners through discussion.

In the package mechanics of learning is considered in relation to the theories of learning, retention and recall. Formulation of instructional objectives, planning, preparing and implementation of strategy are crucial to effective communication. The package starts with objectives given in terms of terminal behaviour(s) of the learner(s) followed by a pretest based on the content of the package. The package describes learning and moves towards the concept of teaching followed by lesson planning and filling up of the specification matrix. On completion of this package the learner is subjected to a post-test in order to assess his/her learning.

The package has a number of visuals for better assimilation of information. Maslow's Hierarchy of Needs has been shown in a staircase format. A curve explaining the relationship between rate of learning and 'time.' This curve also explains the term attention span and the concept of activity variation. Three domains of learning have been represented by three axis x, y and z. The hierarchical levels in each domain have been shown by using overlaying technique. The role of objectives in teaching learning evaluation has been described through a flow diagram.

The package has been finalised on the basis of feedback received from the samples of teachers in higher education and professionals in industries involved in training.

Interacting with computers, interacting with peers, interacting with clients. Multimedia courseware for nursery nurses on CD-ROM

Bryan T Maguire & T Martin Owen, University of Wales, Bangor

Nursery nurses face complex social tasks in engaging in the care of young children. Project Atlantis was funded by the Euroform initiative to develop courseware which would help prepare students and those already in practice to do this work.

The primary goal of the project was to encourage the development of reflective practice on the part of students using multimedia courseware. We wish to encourage students to 'step outside' the situation in which they are working and see how it appears to others. The product includes video clips of nursery activities accompanied by critical commentaries (audio and text). This part of the package was produced using Macromind Director.

The critical scenarios depicted in the videos serve as starting points for interactive role plays. This is facilitated by a hypertext interface. An individual student may take more than one role but the expectation is that two students will share the computer and the role play.

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The package was produced in three languages, English, Welsh and Portuguese. CD-ROM provides the storage space required to duplicate the information and made the multiple versions available in a single resource. It is available only on the Macintosh platform. The product underwent pilot testing in Lisbon and Dublin as well as Wales.

We believe it provides a model for shifting the emphasis in interactive multimedia from interaction with computers to interaction with fellow learners and to others in the real world.

Developing networked hypertext teaching material

David Martland, Brunel University

This paper deals with the production of teaching material to be delivered using networked hypertext.

Changes in educational resourcing during the last 5 years have lead to a great increase in the number of students coming into the computer science department, with no commensurate increase in staffing. A partial solution to the problems which this causes is to use networked hypertext as a communication vehicle between staff and students, and for the presentation of teaching material.

Important factors in the adoption of hypertext to support teaching include:

- network support
- hardware and software support
- hypertext systems selection
- staff familiarity with hypertext
- availability of hardware and software systems

The development of the World Wide Web (WWW) hypertext system has enabled hypertext material to be developed for several classes. However, many teaching staff find the technical skills required to generate hypertext daunting, and thus avoid its use. Further, developing hypertext using the relatively crude tools which are available for WWW significantly increases the production time during a period when staff are seeking to reduce rather than increase the time which they spend on preparing material.

In order to simplify the production of the material, a number of tools have been used or developed, including the latex2html tool (Drakos), a Setext to Latex tool (Martland), and a Setext to Texinfo tool (Martland).

In particular, the use of Setext has made the production of material which can be printed and browsed using hypertext systems very much simpler, and it is possible to produce a document in both printed and hypertext forms with very little additional overhead.

The development of these tools has significantly reduced the time for production of networked hypertext, and made the production task easier.

The proposal here will cover the use of tools for improving the production and delivery of text, and problems which may be encountered with specific types of text, such as mathematics or chemical equations, or text with a substantial graphical content. It will be shown that the adoption of appropriate tools, together with a careful selection of material for delivery, can result in improved student access to material, improved quality of material, with relatively little increase in development effort.

Multimedia support for software engineering

Andrew McGettrick and John Wilson, University of Strathclyde

The Institution of Electrical Engineers with support from the European Social Fund has sponsored the development of multimedia materials to support education in the strategically important area of software engineering. The materials being developed include CD-ROM addressing the subject areas of databases, software project management, object-oriented programming and human computer interaction.

The paper will begin by outlining the motives which underpin this initiative. These relate not only to the current trends towards more student-centred education, but also to the need for continued professional development in an area of increasing significance to engineering in particular and the economy in general.

The main body of the paper will be developed to address the design considerations associated with the database module. Illustrations taken from the database module be provide.

The paper will conclude with some assessments and observations about the final product, the intention being to draw lessons on improvements that might be made in future initiatives.

Development of computer simulation in business teaching in higher education

Alistair McIlroy, Deborah Traythorn and Len Williams, Leeds Metropolitan University

The faculty at Leeds runs courses across Masters to Higher National levels and Information Studies to Manufacturing Systems subjects. The types and use of Business Organisations operates as a unifying theme; each course includes some business modules in its curriculum.

Business has been taught using case studies and as student experience grows, extensive student-independent work using group-work for level 2 activity particularly. Staff wish to extend student use of scenario generation, including the students own generation of these, on these modules and have been investigating the construction of a computer-based simulation of a manufacturing organisation. The simulations of a Virtual Factory and Business Organisation and Lifecycles are two projects running in association to develop students' experience on these modules.

The computer system under development stresses the development of:

- experiential learning
- demonstration of scenarios built using a variety of cognitive strategies
- deployment of strategies which exploit different learning styles
- reflection in the learning process
- the student working in active exploration and learning comprehension and communication

The demonstration will present preliminary findings regarding studies underway of staff and student experiences using current teaching techniques on business related modules and discuss the approaches adopted in building simulations in the Business Organisation and Lifecycle project.

An electronic problem-based study guide

G A Mooney, J G Bligh, S J Leinster and H M Warenius, University of Liverpool

This paper describes the development of Liverpool's Electronic Study Guide for Oncology (LETSGO). The study-guide has been developed for fourth year clinical medical undergraduate students studying oncology in Liverpool's new medical curriculum to be introduced in 1996.

The design of LETSGO uses established educational theory and stimulates learning using a 'problem-based' approach. Learning is centered around a clinical scenario that activates the learners prior knowledge. The clinical scenario also acts as a stimulus for individual and group brainstorming in which the learner identifies issues relating to the clinical scenario. A brainstorm pad enables the learner to record and structure learning issues in two formats: (1) using a sequential text list; and (2) using a *mind map*. A *mind map* builds a graphical representation of issues and draws links and relationships between issues. The brainstorm pad also enables the learner to identify personal learning goals. The identification of personal learning goals forms the first stage in an educational audit loop.

The study-guide provides three forms of self-assessment:

- 1 Free-text questions;
- 2 Extended Matching Items (EMI); and
- 3 An Educational audit loop.

Free-text questions require the learner to enter a short essay-like answer. A model answer is provided. However, the learner cannot access the model answer until certain criteria are met (eg more than 200 words typed or 7 out of 10 keywords present in answer). EMI questions test the learners recall and understanding of knowledge.

Instant feedback is provided to correct a solution and reinforce key concepts. A results screen that illustrates personal progress and progress relative to their peers is included.

Evaluation of LETSGO with medical students suggests that it is easy, enjoyable and intuitive to use. Further evaluations will be conducted to test the educational effectiveness of the study-guide. LETSGO combines the best of information technology with modern educational principles to provide a new supplement to problem-based learning.

Medical education: solving real problems in the virtual patient

Stephen Morris and Jill Szuszkiewicz, St George's Hospital Medical School

Over the last five years patient-stays on the ward have shortened and many are now seen as day cases. This trend will reach the point where much traditional hospital medicine will become General Practice-based.

Medical students traditionally learn their craft (diagnosis, treatment and its management) by observing patients on the ward. Whilst shorter stays benefit the patient, students are denied the raw material from which they learn. Decision-making has also become more complex with the burgeoning volume of diagnostic information available. How can we improve medical education to take account of both these changes?

Much diagnostic information is computer generated, eg CT scans, ultrasound, MRI. Although the patient goes home, these images can remain to form the basis of an idealised patient, of a kind rarely available even before the growth of day care.

The computerised idealised patient, with associated diagnostic images in various modalities, MCQs, challenges, etc, becomes a key case to help the student thoroughly learn all aspects of a condition, by role-playing the doctor. In a computer-aided learning model, the clinical examples are entirely under the control of the course designer whereas on the wards they are unpredictable.

Using the virtual patient, students are able to learn as if by individual tuition rather than as a member of a large group on a ward round.

The virtual patient can be used to structure the learning of the basic sciences that are the foundation of medical practice. Rather than a brief question from the consultant, a more searching challenge can be posted leading directly to a module on relevant background subjects, eg Immunology. After working through a virtual patient program two or three times, the student will have an excellent grasp not only of the ailment in question, but also of the systems that underly its progress and treatment.

A cardiological example of a virtual patient will be demonstrated.

Increasing student-tutor communication through CAL

Stephen Morris and Jill Szuszkiewicz, St George's Hospital Medical School

A major flaw in classroom teaching has always been the embarrassment felt by students when asking for help. Unfortunately, this is particularly true in Universities. The introduction of Computer Aided Learning appears to worsen this situation, since the opportunity to ask for help is removed. In addition the teachers are unaware when problems occur - the blank looks are aimed at the screen, not at the teacher! Follow-up sessions are harder to target, and feedback more difficult to obtain.

The impersonality of CAL, often seen as a disadvantage, can in fact be turned right around, offering an opportunity not found in the classroom. An appeal for clarification made anonymously carries no penalty for the student, and brings the teacher the feedback necessary to keep teaching on target throughout a course.

We have designed a feature, Talkback, implemented with a button, which enables the student to anonymously type in a description of their confusion when it occurs. Their position and path through the software is automatically noted. Its sister feature, the Playback button, is used to recall all the student comments (from the entire class, when networked) in the context in which they were made. This provides a direct line to the students' frame of mind and grasp of the material. This kind of response is far more accurate than an evaluation completed after the event, as the source of their problem is on the screen in front of them.

Its strength is its anonymity - the machine-like quality for which CAL is often de-

spised. Preliminary studies of data collected at St Georges indicate that student frankness is greatly assisted by anonymity. However, is it essential that students are made aware that these comments are used by teaching staff in the design of follow-up tuition. Such feedback can be used to pinpoint and overcome difficulties in course design as they become apparent in practice.

We suggest that this system of clear and honest course appraisal should be implemented as standard on all CAL, since the benefits to both students and teachers appear to be so great.

The changing face of CAL in accountancy

J L Muggridge, EQL International

EQL (a management buyout from the Institute of Chartered Accountants of Scotland) is the major UK provider of CAL material in Accountancy. Over 60 UK Universities, a large number of colleges and schools as well as major public sector and corporate bodies use EQL courseware in a wide range of situations. Access to such a wide user base enables us to develop CAL to meet the changing needs of users and to make objective assessments of the changing marketplace for technology based education.

This paper will review the evolution of CAL material in Accountancy as it has developed from Workbooks to Multimedia and discuss the driving factors behind such changes. The constraints on this evolution and the factors influencing the adoption of such material will also be discussed.

The paper will comment on a number of published papers which make reference to various pieces of Accountancy courseware.

Computer simulation in the teaching of metabolic disorders

Christine Parker-Jones, Rachel Pilkington, Rick Jones and Mark Howes, University of Leeds

The teaching of metabolic disorders is problematic because students find it difficult to envisage the underlying physiological processes and to understand how these change with time. It is important that medical students understand these processes because rational diagnosis relies on extrapolating from them to pathophysiological presentations. Students need to experience a large number of cases because a diagnosis is made either by matching the current case to a similar one already encountered, or, when that fails or problems occur, by working from first principles. One difficulty encountered when teaching using a cased-based model is that students rarely see a completed episode. They are exposed to a series of snapshot encounters and therefore sometimes fail to see connections which occur over time. In addition, it is important for students to practise their diagnostic and treatment skills in a safe environment, without the pressures of the clinical environment.

We believe that computerised case simulation can help satisfy these requirements, by providing a resource of typical cases on which students can practise. Using a model of calcium metabolism and its disorders, we have built a clinical case simulator. Students are encouraged to hypothesise about what is wrong with the patient and, on the basis of this diagnosis, try out various treatment options which are represented in the model. They can see immediately the effects of their actions, presented both graphically and numerically. Embedded in the system, alongside the model, is tutorial material which can be accessed simultaneously. In order to determine whether computer based simulation leads to a better understanding of the interdependency of several physiological processes and treatment effects, a formative evaluation is being conducted to verify the design, and its performance as a teaching aid. It is currently being used in the medical curriculum at Leeds University. Student's knowledge is assessed using MCQs prior to and after use, and concept mapping analysis has been adopted to gain insight into more complex aspects of the students' learning gains.

Enhancing explanation: multimedia knowledge based systems

Peter Phelan and Roy Currie, University of Central Lancashire

We report on a project which develops an actively reasoning form of a legal document and extends its explanatory capability with hypertext and audio/visual aids. Our

work in this area is nearing completion. We have produced an executable formalism of EC Council Regulation 253/93, which regulates the movement of hazardous and other controlled wastes. This knowledge-based system is supported by an environment in which other available media include: the source legislation as a hypertext document; audio files which complement some of the text input in verbal form; and various explanatory visual aids such as maps, diagrams and photographs.

Legislative documents are generally difficult to understand because of the complex reasoning and abstruse concepts which they frequently embody. Knowledge-based approaches can facilitate explanatory legal dialogues, although they are best suited to areas of law conforming to certain well-defined criteria. Multimedia technologies present several opportunities to assist in clarifying the source material. It should be obvious that visual aids such as maps and diagrams can clarify textual information. Audio files, comprising spoken text, may ameliorate the physical difficulty of reading text on screen.

The rule-based representation is substantially derived from a richer textual source; thus hypertext links from the knowledge base to on-line documents would be useful. Although desirable, the combination of KBS and multimedia technologies presents a number of technical and other problems. These are namely:

- increase in development time and additional *media elicitation* phase
- additional demands on experts' time
- preserving integrity of the knowledge representation
- associating propositional elements with appropriate items of media
- increase in difficulty of subsequent modification to the knowledge base

At the most basic operational level, the kind of data manipulated by the inference mechanism is irrelevant; binary is binary. Existing KBS shells, (of which we are aware) however, deal only in ASCII characters. Thus at present, all media links have to be hand-coded. This is the most obvious area in which development costs could be reduced by the production of KBS shells which easily support links with other non-ASCII data.

Using the World Wide Web for student feedback - moving away from paper based questionnaires

Phillip Richards, University of Hull

The introduction of modular courses at the University of Hull has posed a number of problems for which technology based solutions are appropriate. The requirement that students' feedback on all modules should be gauged through questionnaires is a case in point.

At Hull, the Centre for Teaching and Learning Support has conducted a successful pilot student survey in the Department of Engineering Design and Manufacture, and the School of Chemistry, using forms on the World Wide Web. The method has the following key features:

- Many students at Hull have experienced common WWW browsers, which are freely available on the University computer network; students fill in their questionnaires on a standard interface with which they are increasingly familiar.
- An elementary form of passwording is provided using random numbers. This preserves student anonymity while giving an appropriate level of protection.
- Students' multiple choice responses are converted to numbers, then appended to a file on the University's WWW server as a comma separated list. This file can be read straight into any standard analysis package (one is not constrained to the proprietary analysis packages provided with commercial software.) Additional comments are appended to a separate file, which can be printed out.
- No additional expenditure on specialised software is necessary.

As a result of the successful pilot, the School of Chemistry in the University of Hull is to use the WWW method for its main student feedback exercise at the end of the summer term. The extent to which the method succeeds on this scale will be reported to the conference.

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Educational software developed for MT365 Graphs, Networks and Design

Jon Rosewell and Adam Gawronski, the Open University

What kind of code was used by Mariner 9 in communicating with Earth? Where do you brace a rectangular framework to make it rigid? How many colours are needed to make a map with neighbouring countries differently coloured? Can you tile a floor with twelve, six and four sided shapes? How can you assign people to jobs for which they are appropriately qualified? These are some of the questions that will be answered in this problem based course.

Although these problems may seem diverse at first sight, they can all be expressed as problems involving the arrangement of certain objects and the relationship between these objects. The branch of mathematics that deals with such arrangement problems is known as 'combinatorial analysis' or 'combinatorics.' MT365 is split into three interrelated areas - Graphs, Networks and Design, each of which has four units devoted to it.

Each topic naturally lends itself to a software interpretation where many of the ideas presented in the units may be visualised, explored and consolidated in a dynamic graphical environment, where the student is guided through a set of computer activities. Over twenty major packages have been produced, including map colouring, domino, and tiling applications, various graph and network editors, a database of all graphs up to seven vertices, a polyhedra database of all the Platonic and Archimedean solids, a hypertext version of the course handbook, and the implementation of some of the more important algorithms, such as the shortest and longest paths, showing the steps required to reach a solution and allowing the student to control this process.

All the software has been implemented to run on a PC under Windows 3.1 and above.

Integrating multimedia courseware into the curriculum in a weed biology and control module

Chris Settle and Bernard Lisewski, Liverpool John Moores University

Major educational interventions using multimedia technology should be undertaken alongside a fundamental reconsideration of course design. Educational objectives, as specified by learning outcomes, must be appropriate to the multimedia delivery and students prior experiences and expectations of learning. Without these considerations, there has been a tendency to exploit all the available technical advances, and then assume that the end product in itself will represent good teaching. This paper describes a second level three credit optional module, Weed Biology and Control on the BSc Applied Biology degree at Liverpool John Moores University, which has been put into a multimedia CD-ROM format.

It represents a major resource based learning innovation which replaces 20 hours of lectures. This is complemented by traditionally delivered practical work and supporting seminars at appropriate intervals during the course. A new cross platform authoring system has been produced in cooperation with the university's Learning Methods Unit which although allowing some hyperlinking is primarily designed to facilitate the hierarchical understanding of the subject matter and the progressive conceptualisation required in intermediate science based courses. The multimedia format has enhanced the student learning experience through the integrated use of text, photographic images, animation and video that would not be possible under traditionally based lecture formats. Each student is provided with their own CD-ROM and has access to a dedicated suite of computers on demand from 9am to 5pm five days a week during a one semester module. This model allows each student to proceed at his/her own pace within the given time constraints and guided learning staging posts.

The paper will also describe the independent evaluation methodology of the innovation and its outcomes. Student study patterns have been monitored through an electronic tracking system alongside the use of student diaries, questionnaires and semi-structured paired interviews.

Africa in crisis

John Stainfield, University of Plymouth

The use of models to build future scenarios has been revolutionised by the advent of powerful computing facilities. Few of these models are available for student and

teacher use and those that are require some programming skills, are non intuitive, have steep learning curves and require a high degree of lecturer support. Chalmers and Wall have identified a need for models in teaching :

- where no computer programming skills are required;
- which use realistic data;
- which allow the evaluation of the interaction of human and physical environments;
- which regard the understanding of concepts as being as important as the statistical outcomes produced.

Africa in crisis is an interactive simulation which looks at the major physical, social, economic and demographic problems which confront the continent of Africa both at the present time and the probable development of these problems over the next 10 years, focusing on the themes of famine, poverty, health and the environment.

It is intuitive to use, with a simple user friendly Windows type interface, flexible, non linear, open ended and maintainable, giving learner autonomy and capable of use with large numbers of students.

The free standing module enables the user to investigate, using realistic data, the major problems facing Africa and a range of possible solutions taken both individually and in concert. The data analysis is accompanied by background information relevant to the strategy under consideration, with suggestions for reading, questions to test appreciation of the results of the selected strategy or strategies together with an assessment exercise on completion of the module.

Statistics teaching using new learning technologies

Susan Starkings, South Bank University

Statistics as a subject in its own right, as opposed to being a subset of mathematics, has been offered at universities for several decades. The subject has an inherent practical nature which bodes well with new learning technologies. How has the subject changed to incorporate these new technologies will be described. Calculators have statistical functions as standard but have teachers adjusted their teaching methods to utilise these fully? Spreadsheets are widely available and can perform a host of statistical techniques and statistical software packages are no longer just available to the select few. These are but a few of the new technologies that are available to teachers. The paper will evaluate the policy of introducing these technologies into the teaching environment.

Educators should be making the most of these technological advances and maximum utilisation of the facilities available. The fear that some educators have is that the subject will become very technically orientated. That the underlying principles of the subject will be lost since the emphasis is on using technology. Statistics can make maximum usage of the technology without losing its subject content. The choice of what statistical technique to use and interpretation of the results will always be paramount to the subject. Technology has not replaced this decision process only removed the tedious calculations.

The aim of this paper is threefold namely to elucidate the new learning technologies available; to explain how teaching can incorporate these new learning technologies and to demonstrate, with examples, the usage of the new learning technologies.

The WISDEN computer based collaborative learning environment

Bob Steele, Sheffield Hallam University

The demonstration will illustrate the development of a Collaborative Learning Environment (CLE) currently under development at Sheffield Hallam University, within the TLTP phase 2 WISDEN project - a consortium involving seven universities and a commercial organisation.

The overall aim of the project is to develop and make available to Higher Education in the UK a wide range of interactive Computer Based Learning (CBL) material in the area of software design, suitable for use on all three years of undergraduate computing. Specific topics catered for include formal and structured methods for real-time and information systems, together with object-oriented design methods. The CLE is being designed and developed in parallel with the CBL material, which it itself being

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designed to be delivered within the CLE.

A major objective of the CLE is to support students in both individual and group work and to provide tutors with flexible course creation and amendment facilities. To this end the CLE provides an integrated environment offering lecturers:

- A set of harnesses for the rapid development of (CBL) material (based on Authorware and ToolBook)
- An editing environment for building courses from a variety of resources (CBL material, sound, video, text and images etc)
- Structured management of materials through the development of a resource database)

And offering to students:

- Direct access to designated courseware
- A facility to browse resource databases
- Direct access to email and bulletin boards
- Direct access to the Internet
- Direct access to support tools (editors, case tools etc)

Current developments have focused on the implementation of a courseware management system, which enables tutors to put teaching support materials together in the form which most suits their particular needs for a given group of students. This is based on a client-server architecture and utilises mainstream software technologies of OLE2 and ODBC. A course document structure has been specified and a variety of user objects have been implemented to exercise the document structure.

The system is designed for ease of installation, use and maintenance, allowing implementation in various computing environments. The underlying architecture is transparent to the user, as is the standalone or distributed nature of the specific installation.

Further aspects of the CLE currently under consideration include specification and design for: support for peer group working, tutor input to student 'discussion' group, monitoring and assessment, and a consideration of synchronous/asynchronous group communication.

The proposed demonstration will allow delegates to have hands-on access to the *CourseWare Constructor*, allowing them to evaluate the software developed so far.

Health and welfare in the Nineteenth Century: multimedia in the curriculum

Phillip Swan, University of Humberside

Introductory talk on *multimedia in the curriculum* using the example of resources in support of The Social History of Medicine, a unit which employs open learning techniques. A demonstration of *Health and Welfare in the Nineteenth Century* - a multimedia application used in support of the SHM and available on the University of Humberside computer network. Virtual Archive and JORALS Online also available for hands-on evaluation by delegates.

The French TLTP initiative at Queen's University Belfast

Peter Tame, Queen's University Belfast

The reasons for changing pedagogical strategies at Queen's University Belfast, as in most institutions of higher education) are essentially twofold:

- Government policy in education, which is moving towards ever-larger numbers of students at university in the years to come.
- The rapidly developing industry of IT which is able to provide higher education with increasingly sophisticated and more accessible hardware and software.

It is in this context that the ICBL (Institute for Computer-Based Learning) at Queen's University Belfast has established a university-based consortium under the TLTP initiative, consisting of ten academic subject areas.

Queen's University is firmly and positively committed to developing, producing and employing high quality IT courseware to a wide range of disciplines. The languages project (initially French) in the TLTP scheme has produced approximately half the

planned courseware for a twelve-unit French grammar package, designed to teach and consolidate students' knowledge of the language.

With ever-greater numbers of students taught by a relatively small number of staff in French Studies, the need for computer technology (CALL) has never been greater. Learning and revision of language is shifting from book- and paper-base to screenbased programmes which can provide the necessary enhancement and enlivening of otherwise routine, and even boring, learning strategies.

The aim of this paper is to describe the necessary strategical changes in pedagogical methods for which we as a team (academics and ICBL) are attempting to cater, and to illustrate these with some relevant examples taken from the TLTP French programme that we are currently developing at Queen's University.

The French programme is designed with *maximum structural flexibility in mind* for use either as a *stand-alone* package for autonomous and distance-learning or as an instrument for class tuition. It constitutes a genuine attempt to come to terms with new pedagogical parameters and a swiftly-changing education scene. Vision for the future, flexibility in approach and the willingness of academic staff to enter into new forms of collaboration are the principal requirements in meeting the challenge of this complex but stimulating strategical evolution.

Multimedia authoring in HRM education

Richard Thomas, Southampton Institute

A recent undergraduate programme developed at Southampton Institute enables students to graduate with a BA in Human Resource Development Technology. This course combines the knowledge and skills involved in human resource management (HRM) with recent technological developments and applications of computer-based systems. A Level 2 Unit currently offered entitled 'IT Based Training and Development' includes a consideration of the problems associated with incorporating technology-based systems into a broad range of training programmes. A major part of the assessment for this Unit involves the students in producing a 'multimedia' package using a variety of systems including the simple Windows based production tool 'MM-Box 2.' The topic chosen by the students for development had to be related to HRM and the only restriction imposed was that the material should not involve specific IT skills training.

This paper explores the problems associated with the delivery of this Unit, and the impressive results achieved by some of the students. Prototypes for a wide range of multimedia training packages were produced including areas such as Health & Safety, Discipline, Recruitment & Selection, and Presentation Skills. Examples of such material will be outlined and a review of the development of these projects will be given. Finally, an analysis of the results achieved by these students will be provided, and the implications for additional work incorporating technology-based systems with human resource management issues will be discussed.

W(h)ither the book?

Ray Thompson, Sheffield Hallam University

Substantial written texts have been-around for over three thousand years and have been used in Western higher education since the time of Plato. Their position as the core support tool of higher education has been challenged but, as yet, they have not been supplanted by newer technologies.

The printed book was one of the first mass-produced commodities and has already lasted for over 500 years. It has shaped the nature of higher education. For example, its relative cheapness has encouraged the individual possession of large numbers of complete texts, and not merely the collection of hand-written digests and excerpts possible in the days of manuscripts.

The growth of commercial printing created a trade in knowledge and the development of legal rights in copyright and intellectual property. On the other hand, the cost of printing has meant that for generations individuals have had to submit their writings to publishers to gain credit for them. This has created a barrier to knowledge and, because of the cost of printed books, a hindrance to learning.

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The Internet, particularly when using World Wide Web software, provides a new method of publishing, and so a potentially a new way of using the book within education. These electronic books can be copied and updated cheaply, and excerpts can be assembled to make a composite work. The medium supports some multimedia, it is interactive, and so can be used to integrate with other aspects of the teaching process, including assessment and group conferencing.

Does the new electronic book mean a change in the paradigm of using texts within education? Will teachers and students benefit from the development?

A number of problems stand in the way of this happening. For example, there are issues of copyright and intellectual property rights, and those of quality and scholarly standards (and of alternative methods to peer review, perhaps?).

This paper suggests a range of positive non-technical solutions to the development of significant collections, and ways to ensure that the electronic book can become a reliable teaching tool.

Case studies in CAL courseware developed with Excel 5

Joanna F Tidball and Simon B Heath, University of Aberdeen

The aim of TLTP Project LoCAL is to develop a methodology which will enable the production of computer-assisted learning (CAL) courseware to become a more mainstream activity for lecturers through the use of generic Windows application software, such as Excel 5. The approach will enable individual lecturers with the minimum of resources and new skills to develop CAL courseware, which meet their own teaching needs. This approach will extend the current use of computers in teaching and learning without the expense of the team approach to CAL courseware development, involving subject experts, programmers and educational technologists. An additional advantage is that the courseware produced by this approach will be readily transportable between institutions.

The software demonstration will show the potential of this low technology, low investment route to the development of educationally effective CAL courseware. A number of case studies being developed by the Consortium members will be demonstrated: including a Trade Policy Simulation Model, Monto Carlo Simulation of Kinetics, Bending Moment Diagrams for Structural Members, Management Support in Decision Making and the Prediction of Interstitial Condensation. These case studies highlight the versatility of Excel 5, both for modelling and for the creation of sophisticated and user friendly interface, in the development of educationally effective CAL courseware.

IT and the teaching of creative writing: the benefits and pitfalls

John Turner, Sheffield Hallam University

Fully interactive IT Open Learning Program VerseWriter which is compiled in Hypercard 2.1 for the Macintosh. This is a multimedia program using sound, music, animated graphics and movies of poets reading their work. It also contains an extensive glossary of poetic terms and forms. It has been tested on Year 1 creative writing students at Sheffield Hallam University and also with local adult writing groups. Feedback has been enormously positive. The rationale that underpins the program is that poetry is fundamentally an oral medium and should be experienced and tested as such. The program is designed for use by:

- Writers of poetry who are at the beginners' stage
- Students of English who wish to study poetic forms and structure

The program has been written by Ray Globe and John Turner within the University's School of Cultural Studies over the last two years. Our medium-term plan is to seek commercial sponsorship to further develop the program, in two versions. Version 1, monochrome and without movies, and Version 2, colour and with movies.

Technology doesn't cause revolutions: people do!

Les Watson and Lyn Oates, Cheltenham and Gloucester College of Higher Education

This paper summarises the soft systems approach to organisational change adopted by the Faculty of Information Services at Cheltenham & Gloucester College of Higher

Education (CGCHE), to promote development from a teaching driven organisation towards a learning college. It is recognised that such change is enabled through the beliefs, values, attitudes and perceptions of College staff and students.

An appropriate infrastructure has been identified elsewhere as an important ingredient for both the promotion and support of change. Similarly the appropriate use of learning technology in higher education is an essential element in this process of change. However, while the existence of the technology is important, alone it can not effect change. Alone, at best, it can only bring about small pockets of evangelical development.

For a wider and more effective development of the use of learning technology, organisational mechanisms are required which both encourage and support change. Social and political systems within institutions are the real arbiters of change. At CGCHE through the development of strategic alliances and the use of college committee structures, these systems are being addressed.

Effective change starts with the development of a shared vision, and with shared values and beliefs which inform strategic planning. Vocabulary is important to this process, as a new vocabulary can represent new concepts and avoid the perpetuation of 'old thinking'.

It is essential to communicate and publicise the thinking behind new ideas, and to encourage open debate and discussion. It is equally important to resource the supporting infrastructure, and learning centred policies have to be developed across the entire organisation to enable this.

Organisational change is a long term process, obvious immediate results cannot be expected. Change takes time and can only be really effective if firmly based on values and beliefs which have been moulded and reformed following extensive discussion with colleagues.

The impact of SToMP* activities on Microcosm's open learning philosophy

Colin White, University of Portsmouth

Microcosm is a Microsoft Windows hypermedia management system developed at The Media Laboratories of the University of Southampton. It controls the launching of a range of Windows applications through the use of multi-level hot-word linking.

Elementary courseware developed using the more traditional authoring packages generally consist of a single file which typically includes, textual, pictorial and object-oriented information, together with all the associated linking data. In fact, only the hypermedia-type files such as sound and video clips may reside separately and be launched from the main authored file. The resulting courseware possesses a naturally tight structure which is fully defined at 'author-time'. Students then follow one of the prescribed routes through the learning material. As a consequence, there is little chance of the student wandering far from the lecturer's prescriptive learning objectives.

In contrast, CAL courseware, produced under the Microcosm platform possesses a much more open structure. Each application or *viewer*, be it textual, pictorial, audio, video or animation, will have its own file. A particular file will be launched by clicking on the hot word or button link in the active viewer. This directs a command file, known as a *link base*, to launch a particular new application. It is the link base which contains all the hyper-linking information.

Courseware developed under the Microcosm platform naturally tends towards being learner-directed; a typical session resulting in a multiplicity of open applications under the total control of the student. An active textual window will typically contain many hot words, each one capable of opening a new application with its associated viewer. No viewer will be closed unless cessation is instigated by the student. When one considers that the next-generation viewer may, itself, contain hot-words, it is easy to see how the number of open applications can avalanche.

This paper discusses a number of methods of imposing teacher-designed learning pathways on courseware developed under the Microcosm platform, with particular reference to the activities produced for the TLTP Physics consortium program, SToMP.

* Software Teaching of Modular Physics

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Computer aided visualisation of similarities in physics phenomena

Colin White and Allon Alizoti, University of Portsmouth

A justifiable pedagogical technique to aid the understanding of phenomena in Physics is to identify phenomenological similarities and highlight to the student their affinity. This is a particularly powerful approach when dealing with the more abstract concepts of the subject.

Previous studies have shown that many different processes in Physics are derived from a similar framework or are based on cognate mathematical foundations. This paper discusses the development of a suite of computer programs designed to emphasise and thence illustrate comparable physical phenomena.

The programs will include visualisation activities together with their associated mathematical methodologies. A variety of languages and packages.

Two advantages to this approach may be identified:

- 1 The programs will allow the student to study several complex problems concurrently. An appreciation of their relationship can aid the overall understanding of the individual subject areas. Furthermore, the student receives wisdom from a wider perspective than can be achieved by the more traditional teaching methods.
- 2 The technique exposes the student to a more lateral approach to the subject. An appreciation of this as a general problem solving method is a significant attainment.

An IT-based retail teaching laboratory

C Williams and J Davison, University of Surrey

This paper outlines an attempt to develop an IT-based Retail Management Teaching and Research Simulation Laboratory (RELAB) for retail management undergraduate students.

The project involved regular consultation with industry representatives. This resulted in the development of a partnership with leading retailers and IT consultants.

The aim of RELAB is to 'simulate' the retail decision-making environment in a laboratory. The laboratory will run specialist software used by the retail industry to generate learning situations in which students can familiarise themselves with the decisions, within realistic parameters, that managers need to make at every level.

RELAB also provides students with a greater appreciation of retail decision support IT based systems and the scope for using IT in the retail industry. It also contributes to the computer literacy of the students although this is not the main objective. It is more important for students to understand the role of information, and the flow of information, in running a modern retail business. In addition, students will become more aware of the potential of IT to induce various changes in the retail supply chain.

Hence, the focus of the simulation concerns the retail supply chain. Polled Electronic Point of Sale (EPoS) data will be analysed using commercial software to allow students to appreciate the impact of decisions made at various levels. In addition, various stand alone software packages will be loosely coupled with the core simulation to encourage a holistic understanding of the retail environment. This is likely to include store level management simulations, Geographical Information Systems (GIS), store layout and space allocation software, human resources management systems, customer service and personal skills/study skills packages. A multimedia interface to facilitate computer based learning is under construction. In addition, student Email/conferencing and access to the Internet will be provided.

This process (and the resulting methodology) will lead to the development of a model that can be transferred to other learning contexts. It is hoped that this will facilitate further interaction between relevant companies, software houses, consultants and academics.

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Two interactive computer assisted learning resources developed for humanities students at the University of Bradford

Alan Carling, Lynda Prescott and Lawrence Hamburg, University of Bradford

[See Discussion workshop by the same authors - page 24]

Making investment decisions for cost-effective adoption of learning technologies

G F Doughty, H Watt and E Smith, University of Glasgow

The University of Glasgow's institutional TLTP project, 'Teaching with Independent Learning Technologies' (TILT) is studying the cost-effectiveness of IT for teaching and learning. We are interested in how institutions can confidently decide to invest in change. This workshop will raise participants' awareness of the issues, using examples from TILT and their own experience. After a brief introduction we will work for about 45 minutes in two groups, each with a TILT helper.

One group will discuss ways of identifying and measuring costs: total and marginal, equipment, installation, support, maintenance, skills training of staff and students, running costs, teaching staff effort, technical support and maintenance. They may also consider consequential changes in the system, equipment lifetime, variation of marginal cost with volume of activity (eg extremes of usage - little CAL to all CAL) and with phase in life cycle, rate of change of technology relative to rate of change of teaching methods, sensitivity to estimating errors, devolution of budget responsibility, and non-money costs (risk, confidence and uncosted time).

The other group will focus on measuring benefits. To staff (eg job satisfaction and time freed for research); to students (eg by evaluation of learning, assessment results, retention rates, class sizes, increased student numbers, time spent learning specific objectives) taking into account the ratio of study time at the computer to time away from the computer, and asking if time at a workstation is delivery or study; to administration (room usage, top-sliced service provision, laboratory vs workstation space, recruitment competitiveness) and to Funding Councils.

The groups will report back, then discuss cost-effectiveness. This could include business cost-benefit ratios and productivity measures and their appropriateness to HE, eg evaluating development costs per student learning hour. We could discuss whether UK HEIs are moving towards providing the same learning at lower cost, better learning for same cost, or restoring learning quality for an increased student to staff ratio. Finally we could discuss whether efficiency gains are used beneficially, and whether there are valuable uncosted spin-offs, such as changes to flexible learning.

Art Explorer: creating a learning environment

Nicola Durbridge and Matthew Stratford, Open University

Art Explorer is a prototype development which aims to support students as they study in an unfamiliar academic discipline. The focus on 'beginners' problems' - the conceptual, perceptual and effectual distance between novice and expert - is generalizable. Art Explorer, however, is about paintings and is designed to help users look at these productively.

The software aims to offer users a variety of vivid experiences to support their exploration of paintings. It offers a range of moods to engage users, from humour to serious thinking. There are different interactive strategies: meanings that begin in one activity are elaborated through others; users manipulate ingredients in various ways to explore their own ideas and to test out those of experts; they work with words as well as events. The programme combines media for various purposes, eg sound and vision interact to clarify and inform, animations supplant direct experience and direct attention. The computer is used to diagnose learner activity and provide feedback that is personally meaningful.

The main purposes of the workshop would be: to raise awareness of the pedagogical issues that drove the design of Art Explorer, to reflect on the potential of the medium for supporting exploratory learning, and to generate other ideas for educational uses. It would fall into three parts:

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- 1 A brief talk to illustrate the learning needs Art Explorer aims to serve and to establish the pedagogic rationale for its design.
- 2 Delegates experiment with the software.
- 3 Discussion: of the issues raised by this design, by this approach to design, and of the educational potential of the medium.

Catching up with the students: a chance to experience an integrated technological approach to mathematics using graphics calculators and related technology

Harry Gretton and Neil Challis, Sheffield Hallam University

This workshop will provide an opportunity to experience at first hand some aspects of the integrated technological approach to learning mathematics for non-specialists, described in the discussion at this conference by the same authors entitled 'Using information technology to change the way students learn mathematics.'

Participants will have the chance to try out, and examine the educational implications of:

- The TI-85 or TI-82 graphics calculators: these devices have a power which belies the name of 'calculator.'
- The CBL - no, not computer based learning, but the calculator-based laboratory. This recent device (we believe we are one of the first in Europe to be using it) enables physical data on movement, light, heart rate, temperature, sound etc, to be gathered by staff or students in a very flexible and portable way for direct entry into calculators such as the TI-85, enabling mathematics to be instantly related to real world phenomena in everyday settings.

Our main concern is the area of relatively non-advanced mathematics for non-specialists rather than specialist mathematicians, and most of our students are in engineering or science; this is reflected in the kind of approach we take.

In experiencing at first hand the technological approach we take with students, participants may:

- find out something about the capabilities of the latest graphics calculators
- measure their heart rate and temperature to see how stressful the workshop is
- see how fast they can move and how loudly they can sing
- see the famous bouncing beer can
- participate in what we hope will be a vigorous discussion on the implications of our approach for curriculum, assessment, staff development and students' approaches to learning.

Designing an interdisciplinary package: a practical workshop in cross departmental development

M Harrison and S Tickner, University of Glasgow

The workshop will focus on the problems which arise when collaborating departments attempt to design and develop a CAL package to address the learning of 'core skills' applicable across the curriculum.

It will draw on the experience of a multi-disciplinary development team comprising the Numerical Data Group of Glasgow University's TILT Project. With nearly three years experience of such a project, the team are now better able to highlight the potential pitfalls involved in collaboration, and to suggest guidelines for core-skills CAL design.

The package and supporting teachers' tools we have developed will provide the hands-on focus, and illustrate some of the problems we faced. Participants will be invited to suggest alternative solutions.

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Computer assisted assessment

J L Muggridge, EQL International Ltd

Based on work done at the Institute of Chartered Accountants of Scotland, which has included elements of computer assisted assessment in its examination system for many years, EQL have developed Interactive Assessor, a Windows based toolkit for the development and implementation of computer based tests.

The workshop will allow participants to build question banks in their chosen subject and construct tests according to various criteria. Using spreadsheets for results analysis will be included.

New measurement technology in science teaching - how should science courses in higher education exploit IT skills previously developed in schools?

Laurence Rogers, Leicester University

In recent years a succession of national initiatives has encouraged schools to develop pupils' IT capability and its application across the whole school curriculum. A strong influence on this development has been the National Curriculum, which sets out detailed expectations of IT capability. A variety of secondary school courses and examination syllabuses now commonly specify the use of IT. In the particular curriculum area of science, there has been further encouragement due to the availability of novel measurement technology based on the use of computers. This technology has its application in practical laboratory work, and it has been shown to have important potential for improving the quality and scope of such work. The principal benefits are:

- 1 It is possible to gather a wider range of experimental data than is possible through conventional measurement methods.
- 2 There are numerous software tools for analysing data which provide new methods for exploring data ranging from the simple to the sophisticated and encourage an investigative approach to practical work.
- 3 Overall, the technology facilitates a shift in emphasis in pupils' activity away from mechanical collection to interpretation of the data involved.

The workshop enables participants to discover for themselves methods of exploring data obtained from sensors and data loggers used in practical science, and invites designers of science courses in higher education to consider how they might build upon their previous use in secondary schools.

Developing CAL software with Microsoft Excel 5

Joanna F Tidball, University of Aberdeen, and Clive P L Young, UMIST

Many lecturers are already familiar with the use of spreadsheets in their everyday work. The current generation of Windows spreadsheets can be powerful CAL development tools and give individuals the opportunity to develop their own CAL courseware without the need for a development team. The advantage of this approach is that lecturers build on their existing skills, rather than having to learn new authoring packages.

Excel 5 is a very powerful spreadsheet, with many mathematical and statistical functions, and a wide range of charting options. It can be extensively customised using macros written in the Visual Basic for Applications programming language. In addition, a sophisticated user interface can be created through the use of graphic objects, dialog boxes and on-sheet controls, such as command buttons, drop-down lists and check boxes. This combination of mathematical power and a user friendly interface makes it an ideal tool for developing CAL courseware.

This hands-on workshop will demonstrate how Excel 5 can be used to develop CAL courseware. Participants will use a self-teaching tutorial which will take the learner through the development of an example CAL package. The emphasis will be on techniques for interface design and customisation with Visual Basic for Applications.

No previous knowledge of Excel is necessary, but those who already have some experience with the package can start the workshop at the appropriate stage for their knowledge.

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Visit the virtual Monash: a workshop for the geographically-challenged

Jean Wood and Lee Hollingworth and colleagues, Monash University Gippsland, Australia

Our main purpose for this workshop is to give you an experience of being a geographically-challenged, time-challenged learner interacting with teachers in Australia using NetFace, the electronic communications facility developed by faculty and students at Monash University Gippsland in Australia to support their distance education activities.

Netface facilities include email, conferencing, assignment submission, library services and Internet access. The Netface software integrates these components to present a naturalistic menu-driven environment, conceptualised as a virtual university, with places to go classes, cafes, forums, the Union, the Chapel - and things to do in those places, such as working in study groups, circulating research proposals for comment, bringing in guest speakers.

Over the first two sessions you will use the email, conferencing and assignment submission components of NetFace as a student to complete online group tasks. During the third session you will graduate to using NetFace as a teacher. You will turn around assignments submitted in earlier sessions and will then learn how to set up your own online classroom environment.

For some workshop participants this might be their first experience of being geographically distant from their teachers. The asynchronous nature of computer-mediated text-based discussions brings about an attenuation of the interaction that participants used only to 'proximal' teaching and learning might find frustrating. We hope to ease you into being distance learners by first having you meet and talk with your teachers in Australia via the desktop videoconferencing facility CU-SeeMe.

We are proposing to present our story of the development of NetFace and to answer questions related to that in a separate information session so that our time in these workshop sessions might be devoted exclusively to learning online.

Day 1 Say "g'dday" to your teachers in Australia (CU-SeeMe); pick up your Workbook and Reader, online orientation to the 'Virtual Monash' (NetFace)

Day 2 Complete a simple group writing exercise online (NetFace); 'matters arising' to discuss with your teacher (CU-SeeMe); submit your completed exercise as an assignment to your teacher (Netface)

Day 3 Assignments returned (NetFace); design and build your own online classroom (NetFace); debrief and say "see ya later on" to your teachers in Australia (CU-SeeMe)

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The use of CEILIDH at the University of Luton

Derek Allum, University of Luton

CEILIDH is a computerised marking and administrative system developed at the University of Nottingham to assist the teaching and learning of, principally, first year undergraduate 3GL programming languages. We at Luton decided to introduce CEILIDH to assist BSc Computer Science and HND Computing in 1994 and decided to follow the previous year's course at Nottingham as closely as possible: using their course material, follow their mix of lectures, tutorials and practical time, and attempt to follow their timetable for delivery.

Although we initially adopted the same pace as Nottingham had indicated, after some weeks it became apparent that students had severe difficulty in keeping up and we had to slow down. In previous years our *best* marking pace was to mark one exercise every two weeks. This was difficult to maintain with our limited resources. Thus, when we came to use CEILIDH, we were anxious to push the students harder than they had been pushed in previous years.

At the time of writing, only first semester results are known. Luton's two courses mentioned above have examinations at the end of each semester. Comparative results for the two courses taken over two semesters are shown. On the whole the introduction of CEILIDH seems to have had little or no damaging effect on student marks in the two groups.

CEILIDH has provided a means by which students could be progressed more quickly through the subject material. We have reached important topics (eg ADTs) earlier and thus have been able to give these the weight they are due.

We still have to address the problem of attempting to improve the marks of those students who find programming very hard (at least initially.) After this year we have sufficient experience of operation of CEILIDH to begin to write new questions.

An integrated intelligent knowledge-based system to evaluate and improve quality in higher education

Allan Ashworth, Nene College; Stephen Fallows, Myles Harvey and Roger Harvey, University of Luton

This poster demonstrates the development and use of an integrated system that brings together 10 knowledge-bases to provide an overview assessment of quality within an HE institution. Each knowledge-base provides a mechanism to review the performance of a different area of the institution, and has within it around 20 criteria which are assessed individually.

When the IKBS is executed the operator is required to assess the quality of each of the characteristics in any order. When all the required assessments are complete, the IKBS makes a judgment, by means of its inferencing capability, and gives a quality grade descriptor for its own area. It also offers advice on how this grade may be improved. By use of an eleventh knowledge-base, the data gathered from any combination of these knowledge-bases can be integrated to give an overall quality grade descriptor and a more detailed description of the causes of shortcomings in any aspect of performance, where appropriate.

This system is predominately designed to provide a self-inspection tool for an HE institution to enable it to evaluate and thereby enhance the quality of its students' experience and the standards of work within the institution. However, particular knowledge-bases can be used for personal self-assessment, and it is conceivable that the system could be adapted for use by an inspecting agency to evaluate the quality of an entire institution.

The advantage of using such a system is that of consistency. Since different assessors utilise standard criteria within each knowledge-base in the same way, the results for reviews of different institutions will be derived and integrated in a consistent manner thereby relying less on the personal experiences or opinions of an assessor.

This research is supported by a grant from the New Technologies Initiative of the Joint Information Systems Committee.

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Promoting learning technology within the University of Hull

Kathy Beedham, Sue Geale, Philip Richards, The University of Hull

The Centre for Teaching and Learning Support (CTLS) was established in 1994 by the University of Hull to promote quality and innovation in teaching within the institution, with particular reference to learning technology.

The Centre drew together the existing expertise of the AV Centre, the Educational Development Team who encourage the development of teaching methods and the Networked Information Advisor and extended the Universities commitment to learning technology by appointing Educational Technology Advisors under a Learning Technology programme.

This poster will demonstrate the work of the Learning technology team to date and map out the plans for future development. The teams main role is to promote awareness of learning technology and to offer practical support to staff incorporating such technology into their teaching. Initiatives range from a managed series of activities, events and publications aimed not only at promoting learning technology but also identifying interest and expertise already present on campus, to creating network services such as an electronic mail discussion list, subject specific web pages and a bank of CAL software for staff evaluation. This poster will demonstrate the work of the Learning Technology Team to date, including the networked services and map out the plans for future development.

Improving program comprehension through the application of learning theory

C Boldyreff, E L Burd, R M Hather, M Munro, University of Durham

As software applications become older they also become harder to maintain. The reasons for this lie in the poorly structured source code and inadequate documentation. Often previous software updates fail to properly document their changes thus leaving existing documentation also out of date. The AMES (ESPRIT project number 8156) is concerned with application management including program comprehension. AMES recognises that program comprehension is concerned with improving the human understanding process and thus the support for a learning strategy for maintainers is vital. For this reason we have applied the principles of educational learning theory to our program comprehension method. The method we have defined is supported by a hypertext web structure with cross links between related high level concepts to low level implementation details. In addition we have used recommendations gained from empirical studies of maintainers to guide our method definition and tool implementation. The maintainer, in accordance with the learning theory recommendations, is able to select the degree of abstraction which he requires but his overall strategy is supported by a flexible but pre-defined process support provided by Process Weaver. In addition a complete, industrial sized, application tutorial has been defined to demonstrate the benefits of the method and to train perspective users.

A mechanism for bringing application under application management control has also been defined. This method generates, with the aid of a domain expert, the web structure. A number of strategies have been defined which are selected on the basis of the document / source code structuring. At present two case studies have been applied to this method and the tool support. The results have been promising and are currently being used to refine our method. For instance, the effect of bringing applications under the program comprehension environment, in our case studies, has revealed a large number of errors in the source code and documentation. These can therefore be used to direct the maintainers attention to the most appropriate points to start the maintenance process.

Implementing electronic course delivery

S C Busbridge and J Southern, University of Brighton

The concept of 'electronic' course delivery can be thought of as encouraging the culture of information exchange through computer technology and the development of a personal, multimedia encyclopaedia and as such represents the course delivery method of the future for science at Brighton. This paper describes and assesses how this method of course delivery has been implemented in a pilot study in our undergraduate science courses.

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The pilot has been initiated in Physics, producing a low-cost, highly motivating, student-centred approach to the discipline making full use of the 'generic' and 'subject specific' applications of the technology. The process of implementing this mode of course delivery is illustrated by considering the staff and student experience in a typical level 1 mechanics class.

Such a session would normally start with a lecture, as many feel that this is the most efficient way (in terms of time) of introducing scientific principles and concepts. We retain the lecture and describe a method of capturing its 'essence' (i.e. its substance) in digital format and of disseminating it to students. The result is a large multimedia file which students can download to their own machines. Once in their possession, students can edit the file, adding text, sound and pictures to build into their personal encyclopaedias.

We also show how the use of information, data and low-cost programs obtained from the internet or CD ROM can lead to a better understanding of scientific concepts, and to an improved ability to model more advanced problems using readily available packages, eg spreadsheets or computer algebra packages.

Much of the modelling work is completed out of class contact time. Students help each other in such tasks through the use of email and bulletin boards. Staff contribute to this to guide students in the correct direction. We show how this can lead to enhanced group learning in the context of our courses.

The vocabulary of technology

Sue Coles, Manchester Metropolitan University

Computers and their use have brought a whole new set of vocabulary into the world of education.

When teaching students to use software the correct use of terminology is important to avoid confusion. Students often have great difficulty in expressing themselves in 'computer jargon'. Consequently often the only way to resolve a difficulty that a student has with a piece of software is to let them demonstrate their problem on their monitor.

Confusion is not helped by the fact that many terms may be used interchangeably, such as 'button' and 'icon' as the context is only slightly different. Also there are often several ways in which an objective may be achieved, for example, selecting a piece of text when word processing.

To avoid confusion teaching strategy generally involves the adoption of one method for achieving an objective (for example, closing a window) allowing students to discover alternatives for themselves. Terminology can come through practise but a rationalisation of terms may be in order, possibly to drop those which have historical roots, for example 'cursor'.

Moving from development to integration with CAL information skills packages: who are the stakeholders?

Linda Creanor, and Helen Durndell, University of Glasgow

We have now reached the stage within the Library TILT project of giving serious attention to the relevant stakeholders in this initiative - the people with whom we have to work in order to persuade them to use these CAL materials. There are several groups of people that we have to consider as stakeholders in this process:

- 1 The subject (or tutor) librarians who are normally expected to carry out any reader instruction programs and who must be convinced of the value of the material in order to integrate the packages into their teaching.
- 2 Academic staff who have often to be convinced of the need for standard reader instruction and might have to give up more class time for a more concentrated effort to teach information skills.
- 3 Cluster managers who may have great control over how the packages are displayed to students.
- 4 Academics/computing service staff who see it as their job to teach IT/study skills
- 5 Senior management within the library and elsewhere who must be convinced of the need for computer facilities within the library and throughout the campus to make the material available to students.

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Using hypertext is not necessarily a magic solution to the problems that have always been part of reader instruction. As developers of this material we cannot afford to lose sight of the fact that information skills instruction must be timely and should be an integral part of an assessed piece of work. These factors will affect take-up, response and task performance as much as the actual design of learning material and therefore have to be given equal weight in any evaluation.

Any strategy for encouraging the use of CAL material must pay attention to a number of matters, not least of which is the fact that the relevant stakeholders must be considered and an appropriate approach developed that will generate the enthusiasm and goodwill required to bring the students together with the learning materials at the right time. Adequate teaching facilities, such as computer clusters, are the essential final part of the equation.

This session aims to illustrate these points and demonstrate the TILT Information Skills packages.

Hypermedia in education - problems and progress

Mohammad Dastbaz & Stavros Kalafatis, Kingston University

This poster discusses the Market Research by Multimedia (MRM) project which started in 1992 with the aim of developing and evaluating hypermedia courseware for marketing students. The poster gives an overview of the project, discusses the present shortcomings of hypermedia design and the need to expand and develop hypertext design methodology for the emerging Multimedia systems. The poster also presents proposals and design guidelines for hypermedia systems.

Market Research by Multimedia (MRM) is a research project carried out at Kingston Business School with the following objectives:

- To define a design structure for hypermedia courseware.
- To develop a hypermedia courseware for students studying Marketing Research.
- To evaluate hypermedia courseware as a method of delivery against other traditional methods.

The project started in January 1992, finished its design and development phase in May 1994 and is now undergoing its final stages of being tested and evaluated against more traditional modes of course delivery.

The poster would discuss the problems associated with design and development of hypermedia systems, including the lack of standards in hardware, lack of design procedures and structures and the resulting problems in the applications developed. The poster will also present the design structure adopted by the authors in the development of the MRM as well as giving a brief overview of how the project is being evaluated and possible outcomes of the evaluation process.

The real world: teaching, supporting and assessing IT-based course work for 350 geoscience students

C E Ford, University of Edinburgh

Most Geoscience courses at the University of Edinburgh now contain assessed, self-paced computer-based assignments that use a wide variety of applications software, often in combination. There are no lectures, demonstrations or other verbal instructions. Students follow work-sheets, designed with a 3-speed format to allow the more experienced to progress more rapidly. The assignments can be carried out in any one of eight micro-computer laboratories (~400 machines), an innovation made possible by excellent integration of the academic needs of Departments with the management needs of the University Computing Service.

For first year students there are 14 computer based assignments in a course otherwise consisting of 72 lectures, 24 laboratory classes and five field excursions. Students must complete their computer assignments by set deadlines, which are extended in the case of illness, technical problems or misunderstanding. A number of the exercises provide opportunities to solve problems (i.e. for an individual student to waste time being stuck). In such cases support is provided by electronic mail following inspection of students' files on the Departmental Novell file server.

Cooperative working is allowed, but a range of measures are used to deter plagiarism.

Students must submit print-out and save files on the Departmental file server for assessment. Some of the visualisation software gives students only one opportunity per programme run to type the name to appear on the print-out. Some of the assignments require students to compose a descriptive paragraph.

Questionnaire returns for 1994 show that 53% of students claimed enhanced understanding of their subject matter, 82% obtained enhanced understanding of computing, 84% thought the assignments worthwhile, but only 12% relished them in comparison to lectures or laboratory classes. Future developments will include the use of bar-codes to aid record keeping.

Changing strategies in the take-up of computer-aided instruction

Lester Gilbert, Canterbury Christ Church College

Current models of the development of computer-aided instruction (CAI) implicitly assume that the instructional module will be developed ab initio. While this is a fine approach where time, resources, and expertise are plentiful, such a CAI model completely fails to deal with the situational reality of most lecturers and most institutions. Not only are time, resources, and expertise in starkly limited supply, most instructional modules of interest have already been developed and are currently being delivered by a variety of (traditional) methods. Perhaps lacking a polished presentation and an exemplary organisation, such modules nevertheless already have accumulated substantial existing components: texts, diagrams, examples, instructions, tutorials, problems, notes, and so on. Why should significant time and money be spent on reinventing a presumably better module, when the investment in existing materials could be reused at a mere fraction of such costs?

Current methods of development of CAI typically yield a product that is remarkably awkward and costly to change. Indeed, one of the key management factors in evaluating the suitability of CAI is that the end product be stable and largely free of post-development changes. Again, such CAI methods completely fail to deal with the situational reality of most lecturers and institutions. Existing modules are characteristically delivered by a variety of methods and using a variety of materials, whose most salient feature is their great flexibility and ease of modification. Given the 'cut and paste' methods usually used in the development of new curricula, such flexibility and modifiability are vital components of an institution's effective and timely response to perceived market needs. Why should a (presumably) better method of development and delivery be used, when existing methods are so flexible and tolerant of change?

It is precisely these two difficulties which have so hindered the take-up of CAI in higher and further education, and which current initiatives are still failing to address. The paper will identify an alternative approach to CAI development, one associated with the suggestions of Winograd & Flores, which switches focus away from CAI as having to provide a comprehensive, all encompassing instructional environment, towards CAI as involving a rich set of tools which help the lecturer progressively implement his teaching in a CAI environment, without major redevelopment or reinvention. The paper will also outline an alternative approach to CAI implementation, one which is more tolerant of dynamic post-development change, based on the theory and practice of relational data modelling.

Managing change in multimedia courseware production

Joel Greenberg and Peter Wright, The Open University

As a distance learning institution, the Open University uses a range of media to reinforce its teaching programme. It has thus been a multimedia institution since its inception. Printed text and graphics, audio, television, videocassettes and computer software are the media which the University uses to deliver educational materials to its students. The high quality of these materials is due to the specialist skills of staff permanently employed by the University. Academic teaching material in textual form is written specifically for University courses by University academics. Printed text is edited by editors from the Publishing Division with specific academic expertise. Printed graphics is produced by graphics designers from the University's Design Studio. Audio and video material is produced by television producers, graphics designers and broadcast engineers in the University's BBC Production Centre as well as staff in the University's own Audio Visual Department. Computer Software is

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designed and developed by software designers in the Educational Software Group which is part of the University's Academic Computing Service.

All courses produced by the University have their origins within one of the academic areas and are the result of a collaboration between the various specialists mentioned above. This collaboration takes place within a course team structure, with its own production budget and management structure. Specialists from each of the support departments within the University join the course team alongside central academics. Some academic members of the course team may contribute only one printed course unit (course texts are split into 'units' which are a maximum of 48 A4 pages), while others produce written material solely for the course over a two year period.

The computer plays an increasingly important role in the University's undergraduate teaching programme and around 25% of students are studying courses which require access to a PC compatible machine. It is assumed that within several years, a typical student computer will support some type of multimedia application. It is thus essential that the University prepares for this by initiating projects which help to establish a working model for the large scale production of multimedia teaching material in an integrated environment.

The Homer Project has brought together a multi-disciplinary team as described above to recast part of the teaching material from the Humanities course, A295 Homer: Poetry and Society, into a multimedia presentation. The poster will show how the new technologies imposed changes on the way the team worked and how traditional roles were redefined. It will describe how these changes were managed and the guidelines that were established for the next generation of University courses.

The teaching of information technology within undergraduate chemistry courses at Manchester Metropolitan University

Simon Hall, Manchester Metropolitan University

This poster focuses on the implications of teaching Information Technology as an ancillary topic within a chemistry degree structure. Topics that will be discussed include resource requirements, student background (academic and prior IT experiences) and perceived IT skills sought by employers of chemistry graduates.

The aims and objectives of the first and second year IT courses presented in the paper are locally defined and have been determined to a large extent by the change in the students' background. In the past, students have joined the chemistry degree course having studied Chemistry together with Physics and/or Mathematics at A-Level. This background enabled students to study a wide range of chemistry topics since the conceptual overlap between Chemistry, Physics and Mathematics is substantial. This mix of A-Level subjects has progressively changed with time - the number of students studying Physics and Mathematics being replaced first with Biology and then in turn with Geography and a wide range of other subjects. As a consequence the majority of students are ill-prepared for studying Chemistry at degree level.

This decline in appropriate background has occurred against a back-drop of increased need for Information Technology skill attainment. These need changes have been addressed by using the students newly acquired Information Technology skills as a vehicle for providing them with enhanced confidence and skills in mathematical manipulation. This represents a significant support for the teaching of Chemistry.

The range of Information Technology topics encountered by students will be detailed in the paper together with example coursework material and an overview of the teaching methods used.

PROCAL - Partnered, Responsive, and Open CAL

Andy Hamilton, University College Salford

This poster addresses the production and dissemination of high quality, highly portable and highly flexible CAL. PROCAL will:

- engage students through the use of motivational design techniques,
- be portable across diverse hardware and emerging media formats, as appropriate,
- be tuned to precise learner needs.

ICCARUS can be considered as a model PROCAL system. In order to achieve

PROCAL three issues have to be addressed:

- The technology
- CAL design methods
- Organisational strategies

A learner weighted approach will be described commencing with appropriate choice of tools and the adoption of tailoring techniques such as Case Base Reasoning. Recent advances in design methods will be considered such as the use of Video Prototyping in collaborative design and production.

The organisational strategy is the key issue, as PROCAL must be highly resourced in order to be successful. Expertise in the subject area, analysis of educational needs, educational environments and multimedia are essential for design; programming and evaluation skills are needed for production; and, organisational and marketing skills are needed for dissemination. Specialists in each of these areas would be costly, therefore economies of scale must be achieved. This is possible if HE institutions, and other interested organisations, form partnerships. Partners would be of two types, users and developers. Users would buy a share in the partnership and in return would receive the PROCAL. Developers, which may include software houses, would undertake particular aspects of the project development, as outlined above.

We see PROCAL partnerships developing pragmatically. For instance a training simulation of a housing estate might be adapted in cooperation with Housing Associations and Local Authorities for modelling the effects of possible housing policies.

The precepts of PROCAL will facilitate delivery within the HE sector and beyond.

Left brain, right brain

David Hart, University of Strathclyde

This poster will discuss the merits of two people from within the education community but from entirely different branches, collaborating in developing learning technologies.

The poster will be based on the experiences of the author in working with a colleague from the Arts Division on the use of CD ROM technology in Art Education. The author having little or no initial knowledge of Art Education and his partner initially having limited knowledge of IT.

The poster will argue that this combination produced an effective working partnership. The resulting product benefited from the willingness of each partner to learn from the other. With each partner being from different branches, there were no conflicts of academic interest. In fact each partner gained a new awareness not only of the other's subject but also in the communication of their own specialism. The collaboration also meant that any problems regarding the understanding of either the art content or the human computer interface were picked up by the creators. The computer specialist could not get away with jargon or other assumptions on the workings of the software and the art specialist had also to be able to express the ideas and concepts in simple terms.

The poster will further argue that this type of partnership would be equally as effective in other areas of collaboration as it avoids the problems of clashes of academic egos or academic opinion.

The ICP OnLine: an experimental online distance learning network

Chris Hutchison, Kingston University

The ICP OnLine is an Internet-based project undertaken by Erasmus ICP-UK-1429/11. The ICP, which comprises nine universities across EU six countries, was first funded in 1991 for Joint Curriculum Development and Student Mobility programmes in Informatics/Artificial Intelligence. With a view to maximizing the benefit of the programmes to the partner institutions and their students, the ICP embarked in Summer 1994 on the creation of a *virtual university* which, in porting the jointly developed curriculum for the programme to the Internet, would enable the participation as *virtual movers* of potentially many hundreds of students throughout the ICP in addition to the small number of Erasmus students able to move physically.

In its pilot year in 1994/1995, the ICP OnLine is supporting distance learning, virtual

student mobility, and transnational student groupwork. The World Wide Web (WWW), in providing the simplest and most user-friendly access to the Internet through browsers such as Netscape, has been adopted as the student interface to the *virtual university*, with its entry point via an Erasmus *home page* on a server located at Kingston University, the coordinating institution. Resources to facilitate the *virtual mobility* of email-linked transnational student teams include links from the *home page* to a description of the Erasmus project itself, to partner institution WWW home pages, to profiles of the participating universities and the cities in which they are located, links to syllabi, courseware, bibliographies, research reports, project guidelines, CVs of tutoring staff, cultural resources and relevant *social Usenet* newsgroups, and pointers to European language resources, including electronic newspapers, journals, books, and dictionaries. Students successfully completing the programme will, in addition to the normal assessment for a home degree, be awarded an ICP *Certificate of Participation* acknowledging their participation in the Erasmus ICP OnLine project.

The poster session will present the *work in progress* and the developments planned for Community Learning Resource Centres in the light of our collaboration with EasyNet/Cyberia, Question Mark Computing, Birmingham Leisure and Community Services, and the Open University of the Netherlands.

Shifting resources - coping with new budgetary responsibilities

Gabriel Jezierski, University of Durham

Changing patterns of internal funding arrangements and cost centres in higher education have led to increasing financial responsibility falling within the domain of academic staff. They are now having to deal with budgetary arrangements for a variety of purposes.

Whilst academic staff feel comfortable writing the rationale, background, aims, expected outcomes etc, for proposals, indications from academic staff working collaboratively as members of the consortium on the TLTP2 Project 45 TLTP Project: *Core IT Skills for Teaching and Learning in Higher Education: Tools for the development of a National Framework* have indicated that they are having increasing budgetary responsibilities and very often feel ill equipped to tackle such costing exercises and lack support or advice on how to go about it.

As a result two areas have been identified where practical help would be valuable:

- Costing a 1 day Workshop
- Preparing a costing for a proposal for funding an IT related activity

This poster will describe each, indicating the rationale for the work, the type of components which need to be identified and, the type of questions which need to be asked (and answered) to accurately cost out the work. In each case the result will be a respectable attempt at costings which could then be put forward to the relevant finance officer for finalising.

The aim is to offer academic staff practical help in addressing the question "How much would it cost"?

Superior teaching and learning of orthopaedics through technology

George Kernohar, Gerry Mulvenna, and George Munroe, Queen's University, Belfast

Objectives

To enhance use of images in medical education, to digitise 2,000 35mm slides on orthopaedics, to create digital image database for use at departmental level, to allow student access using University Open Access UNIX network and further afield using JANET and to examine performance of existing computer-based material.

Methods

Slide digitisation was followed by an initial display system, written using a self-learning programming language developed at QUB. Feedback was available on students' performance and allowed students to use computers in their teaching. However due to speed constraints and the size of the database the project has outgrown this system.

The system was next developed using Paradox for Windows. Tables were created: each one holding slides with a common theme or clinical subject. Each compressed file was

loaded into a table. Text/visual tutorials could be created either on the master system or for further transfer onto subsequent workstations. However, the Paradox database has now also become inadequate, particularly in network usage.

A new worldwide access system has been developed making the image database available at all networked UK Universities and indeed worldwide using widely available network software (NCSA Mosaic) to display files using hypertext markup language. Programs have been written to display 'pages' of data, with each comprising text and images.

Assessment

A basic computer-based learning package is provided to students who are timetabled to work through the tutorial during their orthopaedic attachment. They record the effectiveness of this experience using a questionnaire.

Our own evaluation of the project is very satisfactory- objectives are being achieved and extended beyond the original aims. There is positive evidence of external evaluation. The quality of image regeneration has been described as 'outstanding.' Each of the 112 medical students who have used the first version of the program have completed assessment forms, giving their opinions of the software, quality of images, etc. These have now been analysed and the feedback has been positive. The new developments in computer technology will allow access to these digitised images worldwide so extending the project and produce substantial innovation in teaching and learning.

Developments towards becoming a learning organisation in the School of Computing & Mathematics at the University of Huddersfield

Barry S Lee, The University of Huddersfield

The School of Computing and Mathematics at the University of Huddersfield is seeking to become a learning organisation. This paper will discuss aspects of adjusting the mission, teaching/ learning strategies, resourcing the changes, and staff development.

The first and most important aspect of the project is to give due weight in the School's mission to learning. This requires:

- an outcomes-led curriculum
- incorporation of transferable/core skills
- evidence-based (eg portfolio) assessment methods
- recognition that learning in the workplace is as valid as learning in the academic institution
- explicit support for learners
- active learning styles
- learner self-assessment and use of reflective diaries and profiling.

It is based on the belief that modern vocational courses need to develop reflective practitioners rather than technical experts.

Placing emphasis on learning leads to teaching/learning strategies which are technology- and workshop-based, and experiential. They may be called design studios. Mechanisms have to be put in place to ensure that:

- learners are prepared so they can get the maximum benefit out of the learning
- projects can be organised so that learning can be facilitated and evidence gathered and suitable methods are agreed for assessing performance
- learning achievements are accredited in the most appropriate way.

Organisations which value learning consider their staff to be their key resource and are prepared to invest time and money in staff development. Approaches which emphasise learning and self-assessment by learners redefine the relationship, redistribute power from the tutor to the learner, and grant greater independence to the learner. Clearly there is a cost in staff development to equip staff to carry out the role of facilitation, and in the changed use of people's time.

The introduction of such strategies has implications for all aspects of resourcing, including accommodation and the use of space, computing facilities, and staffing. This involves both School and central funding of learning support, particularly in the form of information and computing resources, and of support staff such as counsellors, careers advisers, librarians, and technicians.

Teaching computer science using hypertext

David Martland, Brunel University

This poster will deal with the use of electronic communications, and in particular networked hypertext, to support the computer science curriculum, both as a delivery method, and as an active teaching method. Consideration of the methods for teaching of other subjects will also be given. There are many issues related to the use of hypertext for teaching, including:

- the production of material
- the nature of the interaction with students
- students learning to use hypertext
- selection of hypertext software
- staff training
- the provision of accessible hardware and software systems
- the learning outcomes of using hypertext

This poster does not address the problems of document production or software selection, but concentrates on the interaction with students, and the learning outcomes. Techniques for helping students to learn based on networking technology have been tried, including:

- use of electronic mail for queries
- use of newsgroups for communication with class members
- use of Gopher or WWW (World Wide Web) for delivery of material to students
- use of WWW by students for producing hypertext material

These techniques will be discussed together, and particular reference will be made to the use of student developed hypertext. The benefits of student developed hypertext appear to be:

- students become more motivated
- assessing student work is simpler
- the best student work can be reused by other students

However, there are a number of disadvantages:

- some students resent learning to use a hypertext system
- hypertext may not be "directly" relevant to the course
- poor performance of the hardware and software systems
- testing student software may be difficult
- archiving student work for future use may present technical problems

This poster will describe various methods of encouraging student interaction with hypertext systems, including the use of networked hypertext within a workshop context. Each student was required to maintain a hypertext 'portfolio' of work, and to participate in group exercises with a hypertext deliverable.

The author's experiences with students' use of electronic communications and hypertext since 1992 will be discussed in greater detail, together with pointers for improvement, and an evaluation of the work which has been carried out.

Reference will be made to Peter Brown's work at the University of Kent, in addition to the work which I carried out with students taking workshop courses in 1993-4, and formal systems courses in 1994.

Learning style and computer mediated learning: action and reaction

Patricia Paterson and John Rosbottom, University of Portsmouth

Learning style can be considered as a predisposition to adopt a certain kind of behaviour when engaged in the learning process. This behaviour is influenced by the ways learners process information, and how they react to certain learning situations and environments. These learning situations and environments may also in their turn be expected to influence learning style. In a time of rapidly changing learning technology, such as we are now experiencing, it is essential to provide the maximum support for the student who is expected to take increasing personal responsibility for management of learning. One way of doing this may be to offer advice stemming from investiga-

tions into correlations between learning style and success as measured by tests and assessments.

Analysis of examination results for the above students has revealed a consistent significant correlation between aspects of learning styles as identified using Kolb's Learning Style Inventory and the success of the students, both overall and in individual units of the course. Similar testing for 1994-5 so far indicates a less significant but still present correlation. Retesting of these students has also suggested that a noticeable modification of learning style occurs on this course. There is no conclusion that possession of certain learning styles leads to success; too many other factors are involved. But it is suggested that offering students proactive advice stemming from completion of Kolb's LSI at the beginning of their course may be more beneficial than giving reactive advice after their success (or otherwise) has been measured.

This poster continues the investigations into the use of interactive multimedia by postgraduate students following a Masters course in Information Systems (1993-4). These investigations were discussed in a paper given at ALT-C 1994 and subsequently published in the Conference Proceedings.

Workbooks - a low-tech teaching/learning aid

Helen Pearson and John Cookson, University of Leicester

The Medical Faculty at Leicester were concerned that medical students should concentrate on basic clinical skills during their first clinical year. Student logbooks were devised to fulfil the objective of focusing the tutors and students on a student-centred approach. The assessment attempts to give criteria within the constraints of the book size and functions essentially as an OSCE (Objective Structured Clinical Examination) 'on wheels.'

It consists of a set of basic clinical skills to be signed as competent by clinicians. The other sections, which students record for themselves, contain skills which they were taught, clinical skills which they should see but not perform, and commonly presented complaints and abnormalities.

The assessment section of the logbook is formative and students are able to control the rate at which they are assessed. The problem of comparability between consultants is not considered an issue, as each student is attached to eight different consultant firms during the year, and the assessment facet of the exercise is primarily concerned with identifying, to both student and tutor, the few - ten percent - of students who are not performing satisfactorily at this stage.

The logbooks are reviewed three times a year, to allow a close watch to be kept on students who are not performing well. At the end of the year, the clinical sub-dean interviews poor students. Poor performance may be because the student has poor clinical skills, or because they are poor students. Either way, the information is valuable that this early stage in the students' clinical experience so that remedial action can be taken. Logbooks have the added advantage of being relatively low-tech and inexpensive.

A variation in assessment exercise to encourage self-learning

Thurai Rahulan, University of Salford

Two years ago, two new degree programmes were initiated which were aimed at the students who had achieved a first degree level in Engineering. Engineering Computation was adopted as a mandatory subject with minor modifications at the peripherals to customise it for the appropriate degree programme. The teaching commenced for the first time in October 1993 and towards the end of the course, it became apparent from the student submissions, that there was a deficiency in the students' ability to write lines of codes for programming purposes. On closer investigation, it transpired that, despite requests to perform certain exercises, there was a general reluctance to spend time on this section of the course. The main reason was the belief that the 'traditional' languages had had their day and that 'more user-friendly' software packages had taken over!

In order to emphasise that this was not yet the case, the students were set exercises in a more vague manner which necessitated the insertion of additional lines of code into the software package. This illustrated the finely detailed control authors could exercise

in order to customise the product. Furthermore, it was emphasised during the 'hands-on-keyboard' sessions, the importance of not blindly accepting the computer's output as the 'word of god'. As if to lend support to this argument, the arithmetic flaw in the early Pentium processors was discovered during this period, and this stroke of 'good fortune' enabled the author to make full use of the associated 'Pentium adverse' publicity material to drive home the point.

It is believed that, as a result of such changes in the teaching approach, the students were encouraged to carry out their own individually designed 'tests' to confirm the first set of results. Such individualism promotes self-learning to the extent where an average student would require only a detailed introduction to each section. The final set of assessment figures and interviews with the students who have just completed the course seem to indicate not only a better understanding of the various methods but also a better appreciation of the pros and cons of the different techniques and, most importantly, the limitations of applicability of each approach. Since this variation in the learning technology has been successful, the author is hoping to develop this method further and extend its application to the other subject disciplines.

IT - an integrative technology

José Rowe, Liz Hill and Brenda Eade, Anglia Polytechnic University

The paper will be based upon the authors' personal experiences of computer related developments in education from the early 1960s to the present. Examples and recent case studies will be used to illustrate the thesis of the title in the context of new partnerships developing between academic colleagues and between Higher Education and external organisations.

Current developments - new partnerships

With the wider access available to Higher Education students to commercially used packages and 'user friendly' IT facilities has come the practical use of group projects drawn from real problems. A particular area of cooperation between academic staff, Computer Services and employers is survey and questionnaire design and analysis. Over several years now students on marketing courses at Anglia have cooperated on problems originating from 'real' clients, often charities.

Illustrative examples will include a whole class working on a project for the Wildlife and Wetlands Trust; a smaller team on a survey for the local Museum service; a new Masters course involving a project for Eastern Arts; individual students returning from a 'sandwich' year with employer driven projects. The students gain experience of the real-life situations which come from working in a team on 'real' problems; liaison with an external client; working to deadlines using a range of skills and techniques applied to a genuine situation.

Case studies

There will be a detailed account of one project which has been completed where staff of Business Studies and the Computer Service worked together for a term with a class of students. The students discussed the requirements with the client and at the end of their term's work provided a presentation and report of their findings based upon an interview survey and its computer analysis.

The second case study will relate to work now being completed by students on a Masters course in Cambridge where the client, Eastern Touring Agency, had already designed their questionnaire for input using the Optical Mark Reader at Anglia Polytechnic University and wanted this analysed and the findings related to recommendations.

Experience gained from these integrative and cooperative projects will be included in a final summary of future possibilities for enhancing student experience and offer an alternative scenario to that of the common fear of IT encouraging socially withdrawn behaviour, with youngsters able to communicate exclusively with their machine.

Information technology in the business curriculum: meeting students' changing needs and expectations

Jane Scivier and Liza Pybus, the Nottingham Trent University

Business schools must ensure that they equip their graduates with appropriate Information Technology (IT) skills and knowledge. The IT curriculum offers those with

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responsibility for its management, design and delivery a number of specific challenges. The challenges arise from two areas. The first relates to the growing diversity of the undergraduate population in general and their IT skills and expectation in particular. The second is a product of the subject matter. The IT subject/ skills domain is exposed to a high and rapid degree of change, due to external technological developments and developing understanding of the organisational impact of IT. Consequently the curriculum requires frequent and informed revision.

At Nottingham Business School the prime objective of the IT curriculum is to 'add value' to the educational experience of our undergraduate population. We aim to provide students with current skills and knowledge which are marketable, but underpinned by a learning for life approach, which includes an on-going awareness of technological developments. In order to achieve this we must be aware of how students needs are changing. This poster will illustrate the processes that have been put in place to provide us with a view of our students' changing IT needs. The findings for 1995 will be displayed and we will be willing to discuss the implications for curriculum design and delivery.

The independent learner: a study of self-managed learning in post graduate management education

Lynda M Stansfield (formerly Smith), University of Huddersfield

The encouragement of independent learning has been promoted by many as an appropriate response to the changing demands of the many stakeholders in higher education, and to the problem of ever-diminishing resources.

The literature is plentiful from the academics' and employer perspectives. However, very little attention has been spared for experience of the students. It is unacceptable for those who are responsible for the setting of policy on higher education to work on the basis of their own perceptions and experiences without understanding the many implications for the student. Therefore, research into learners' perceptions, experiences, needs and aspirations is essential in order to take account of their needs in order to develop learner independence.

The author is an experienced management development practitioner and senior lecturer involved in the concept, design, delivery and evaluation of a range of education programmes which encourage student independence. She is concerned about the emerging trend for blanket application of independent learning strategies, often without an appropriate appreciation of the recipient experience.

A study has been conducted in order to address some of these issues. The investigation has monitored the progress of two cohorts of post-graduate, post-experience students on a newly designed modular Diploma in Management Studies programme over two years. Quantitative and qualitative data has been collected at several points during the programme.

The study has produced some interesting findings. The Management Skills module, which introduces and develops key independent learning skills, attracted one of the highest student satisfaction ratings: 87% of all responses were in the more than satisfied and very satisfied categories. However, evidence shows that there was a mismatch amongst a significant proportion of students between their expectations of 'the University experience' and the reality of that experience. These feelings were at their highest in the first year of the programme. By the end of the second year, students were beginning to respond better, and to see the benefits of independent learning. Self-managed and experiential methods seem to be successful in promoting motivation to learn more, and in creating an atmosphere conducive to learning. Most respondents complained about a severe lack of time, which also coincided with increasing burdens in their employment workloads. Tensions arose because they expected tutors to play a particular role, when in reality that role turned out to be quite different. Students perceived a lack of direction and concern in the way tutors encouraged them to identify their own needs and to find ways of meeting them.

The detailed findings and conclusions will be discussed with delegates, as a stimulus for debate, and to set an agenda for further research.

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Tables for learning

Pauline Steere, Chichester Institute of HE, & Patrick Sharkey, University of Portsmouth

The naive practice of representing tracts of abstract reasoning or the nitty-gritty of a tedious concept by an array of outcomes is implicit in various parts of mathematics and science.

While a table may not have the aesthetic appeal of a drawing nor the proverbial 1000-word value of a picture, less still the riveting effect of the moving picture with sound-track, it has often acted as a useful learning aid. (Perhaps, the static array does not lend itself to the observer remaining passive!) Examples - apart from our school day log and x-tables are:

- truth-tables in logic
- nett-present-value tables in business
- matrices to represent linear maps

and - more loosely -

- spreadsheets in computing
- crystal lattices in physical chemistry

In algebra, the (19th century) Cayley table for a finite group is special because it contains all of the content of that structure. Moreover, study of groups (and similar classical algebraic objects) is found to be difficult by undergraduates, when presented in the traditional axiom-deduction-theorem sequence. Indeed, experience shows that where students drop out of abstract courses, there is the serious long-term risk of their avoiding abstract reasoning for the rest of their careers.

Recently, we sought to address one aspect of the problem, by writing a user-friendly Turbo-Pascal 6.0 package for maths students. Its simple features (easy internal movement, primary colours, a few table-related exercises, and only as much text as was needed to interpret the entries) appeals to students, left cold by print or by the grey density of (the same) material in more comprehensive packages like MAPLE. The package is nevertheless only a pioneer to a fuller course or a more advanced package.

Current developments, not yet reported, are in two directions:

- a enlarging existing pairs of tables for medium-order fields which increasingly underpin Codes/Cryptography and applications like smart cards;
- b diversifying to the construction and Spartan text for Latin squares, relevant to experimental design in statistics.

Virtual archive

Dr Philip Swan, University of Humberside

Poster - Virtual Archive (with demonstration of the software on the stand) on work in progress on my current project 'Virtual Archive' - resources for history; and 'JORALS On-Line' - a networked version of the Journal of Regional and Local Studies.

Approaches to publishing hypermedia electronic books

Check Meng Tan and Philip Barker, University of Teesside

An electronic book is a structured electronic document which consists of pages of reactive information. Such Books range in complexity from simple linear collections of pages through to sophisticated hypermedia productions which embed many different types of modality and media component.

The term 'hypermedia' electronic book can be regarded as an integration of hypertext, sound, static pictures, animation and motion video in order to compose books that support non-linear access. Obviously, the nature of the medium that is used to publish hypermedia books will strongly influence the properties of such publications. Media characteristics allow three basic types of hypermedia book to be created: static, dynamic and living.

Before hypermedia books can be published in an effective and efficient way, a number of important problems have to be overcome. These problems fall into three basic areas: authoring, specification, and publication. Within the context of authoring, three major problems are: the 'completeness' problem: resource production and integration; and the difficulties associated with group authorship. Specification problems arise due to

the range of different markup techniques that are available and the lack of tools to support this activity. Publication problems arise due to access time, media capacity, global connectivity and limited bandwidth.

In this proposed poster session the results of our investigations into the use of different media for publishing electronic books will be described. This will involve a demonstration of a prototype electronic library that has been published on CD-ROM in the form of a 'gold disc.' A series of electronic lectures that form the basis of a number of hypermedia electronic books will also be demonstrated. Some investigations into the use of computer networks (Internet) as a publishing medium for living' electronic books will also be outlined.

Computer aided visualisation of similarities in physics phenomena

Colin White and Aliou Alizoti, University of Portsmouth

A justifiable pedagogical technique to aid the understanding of phenomena in Physics is to identify phenomenological similarities and highlight to the student their affinity. This is a particularly powerful approach when dealing with the more abstract concepts of the subject.

Previous studies have shown that many different processes in Physics are derived from a similar framework or are based on cognate mathematical foundations. This paper discusses the development of a suite of computer programs designed to emphasise and thence illustrate comparable physical phenomena. The programs will include visualisation activities together with their associated mathematical methodologies.

A variety of languages and packages will be utilised including Visual basic, ToolBook, Delphi and Animator. The aim of the programs is to aid the understanding of Physics phenomena by comparing the phenomenological instance with a less abstruse and easier to comprehend instance of a similar phenomenon.

Two advantages to this approach may be identified:

- 1 The programs will allow the student to study several complex problems concurrently. An appreciation of their relationship can aid the overall understanding of the individual subject areas. Furthermore, the student receives wisdom from a wider perspective than can be achieved by the more traditional teaching methods.
- 2 The technique exposes the student to a more lateral approach to the subject. An appreciation of this as a general problem solving method is a significant attainment.

The opportunistic use of resources in developing Computer Aided Learning systems

Andrew Williams, Manchester Metropolitan University

This poster traces the development of Sim8086, a Computer Aided Learning system for supporting the teaching of assembly language programming to first year Combined Studies students. Ironically, the system has been developed as a result of a change in the author's teaching. The system was originally envisaged as an undergraduate project, which might, if successfully completed, make a useful contribution in teaching students in future cohorts. However, because of the difficulties the current cohort were having, the system had to be developed (extremely rapidly) by the author himself. The author explores the reasons for the difficulties faced by the students and shows how the system attempts to address these problems.

The system was developed using Microsoft's Visual Basic, which supports rapid prototyping of Microsoft Windows systems. The first working prototype of the system was completed within seven days. The poster identifies the strengths of Visual Basic as a tool for creating CAL systems and also gives some guidelines for judging its appropriateness for different types of task. These guidelines were drawn from an earlier MSc project supervised by the author.

The poster then goes on to describe the author's attempts (in his role as Projects Tutor) to encourage the use of BSc and MSc project students to support teaching and research across the department. The author's (successful) attempt to use an undergraduate student to support the development of Sim8086 is reported. The paper concludes with a discussion of the risk inherent in attempting to use students to support the development of CAL systems and some tentative suggestions as to how this risk can be reduced.

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